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A MANUAL

OF

MIDWIFERY

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A MANUAL
OF
MIDWIFERY

BY

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ILLUSTRATED WITH 271 *ENGRAVINGS*

FOURTH EDITION

LONDON
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1897

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PREFACE

TO THE FOURTH EDITION.

In the present edition ten new figures have been added. Revision has chiefly been required in the chapters on the development of the placenta, on extra-uterine fœtation, and on puerperal septicæmia. A section has been added on deciduoma malignum.

49, Wimpole Street,
December, 1896.

PREFACE

TO THE FIRST EDITION.

THE object in writing the present work has been to produce a book which should be literally a manual in point of size, and yet should include all that is likely to be required by students or practitioners.

In order to save as much space as possible, I have omitted any general description of the anatomy of the female sexual organs or of the development of the embryo. These subjects belong more properly to works on Anatomy and Embryology respectively, but they occupy no inconsiderable space in most text-books of Midwifery. As regards anatomy, I have included only those points about the anatomy of the pelvis as a whole which have a bearing upon midwifery. As regards the development of the ovum, I have included only what is necessary in order that the formation of the placenta and the fœtal membranes may be understood.

On most practical subjects the teaching of this book will be found to agree with that generally adopted by British authorities. On a few points, I have ventured to give recommendations differing from the opinion of the majority. Among these may be mentioned especially the choice of leg to seize in version for shoulder presentation; the application of a noose to the prolapsed arm; the use of a serrated hook for decapitation; the use of the vectis in protracted labour with an unreduced occipito-posterior position of the vertex; and the use, under very exceptional circumstances only, of an oscillatory movement in extracting with forceps. The last practice is, by most authors, either recommended as a general rule, or altogether denounced.

On some theoretical points also, the mode of explanation will be found to be original. Among these are the mode of demonstrating how flexion of the fœtal head is produced by the pressure of the girdle of contact (Fig. 84, p. 177); the account of the opposite modes, as regards flexion and extension, in which the fœtal head may pass the brim of a flattened pelvis; the proof that correct axis traction may be exercised by ordinary long-curved forceps (Fig. 222, p. 632); the account of the leverage action of forceps; and the explanation of the lateral obliquity of the fœtal head.

The section of the pelvis, parallel to the plane of the brim, and passing through its points of support on the heads of the femora (Fig. 13, p. 12), has not, so far as I know, been hitherto figured in Obstetric works. It appears to me to afford the best means of studying the effects of the body-weight, and the reactions to the body-weight, on the shape of the brim, both in normal and deformed pelves. For it is only the components of the various forces resolved in the plane of the brim, or parallel to that plane, which directly influence the shape of the brim, or of parallel sections of the pelvis.

In the account of the mechanism of labour, both in the normal and flattened pelvis, I have endeavoured to make the description of the subsidiary movements of the fœtal head and their causation as simple as possible, and, at the same time, mechanically and geometrically sound. Special attention has been given to the mode of production of the different forms of distorted pelvis; and also to the changes in the normal pelvis during the advance from infancy to maturity, since a correct interpretation of these goes far towards explaining the production of all deformities. I have tried to show that all the important peculiarities of shape in all the different forms of pelvis may be explained by the modified action of a few simple mechanical influences which act upon all pelves, whether normal or deformed. I have adopted a classification of deformed pelves different from that usually followed, and have divided the various kinds of deformity, not according to their causation, but according to the shape of the pelvis. In this way, those forms of pelvis which are similar in their obstetric relations are grouped together.

In matters calling for statistical evidence I have frequently quoted from the records of the Guy's Hospital Lying-in Charity. These records contain a large amount of material, since they have been kept ever since the year 1833, and, of late years, the number of deliveries attended yearly has exceeded 2,000. The remarkably favourable results both to mothers and children obtained by the high forceps operation in contracted pelves (see p. 545), appear to be specially worthy of note, since by many Continental and American authorities this operation is regarded as being, under these circumstances, much more dangerous than version.

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Local.

Vaginal douche of bini
　Hyd perchl. 1–2000

If diarrhoea clyster in enema
　creolin (1–1000)
　　　　　　　　aa-O_3
If offensive discha peroxy. [illegible]
　after each douche

Intrauterine injection very good
not done c̄ extreme caution.
　If Supp. of lochia
Hyd Perchl. 1–1000
[illegible] 1–4000

) Curette c̄ in 4–5 hrs.
Only exam. [illegible] [illegible]
Digits
instrument

[illegible] of [illegible] would be [illegible]

get out [illegible] with a [illegible]

[illegible] the bed is brought down

[illegible] Coat [illegible]

[illegible]

of the [illegible] area & the [illegible]

[illegible] This [illegible]

[illegible]

[illegible] Repeated the adaptation

[illegible] is necessary to be [illegible]

is an [illegible]

[illegible] with the [illegible]

[illegible]

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A
MANUAL OF MIDWIFERY.

CHAPTER I.

ANATOMY OF THE PELVIS.

THE study of the anatomy of the pelvis is of primary importance for the obstetric art, since upon the disproportion of its size to that of the fœtus, or abnormality of its shape, depends a large proportion of the difficulties which are met with in delivery. The pelvis is a structure adapted for fulfilling many functions at once, and its obstetric functions are greatly influenced by the purely mechanical conditions to which it is subjected. It forms (1), a bony ring, by means of which the weight of the body is transmitted to the legs; (2), an axis for the movements of the legs upon the trunk; (3), an attachment for many of the most powerful muscles of the trunk and of the legs; (4), a cavity to contain the pelvic viscera; and (5), a bony canal for the passage of the child in parturition. The rough external surface, with many prominences to afford leverage, is adapted for the attachment of muscles; the smooth internal surface is suitable for the passage of the fœtus. Owing to the erect posture of women, the contents of the abdomen and pelvis tend to gravitate towards the pelvic outlet. Hence there is a mechanical difficulty, which does not exist in the case of animals, in rendering the structures which close the pelvis strong enough to prevent any undue yielding under pressure. There are two peculiarities in the formation of the bony pelvis which tend to diminish this difficulty. First, the considerable inclination which the brim of the pelvis has to the horizon in the standing position has the effect that the major portion of the weight of the abdominal and pelvic viscera rests rather upon the anterior abdominal wall and anterior bony wall of the pelvis, than upon the soft parts which close the pelvis inferiorly. Secondly, owing to the curvature of the pelvic canal, greater than that of the pelvis of animals, the lower part of the sacrum and coccyx afford some measure of bony support to the contained viscera, and give a firm attachment to the muscles and other structures which constitute the pelvic floor.

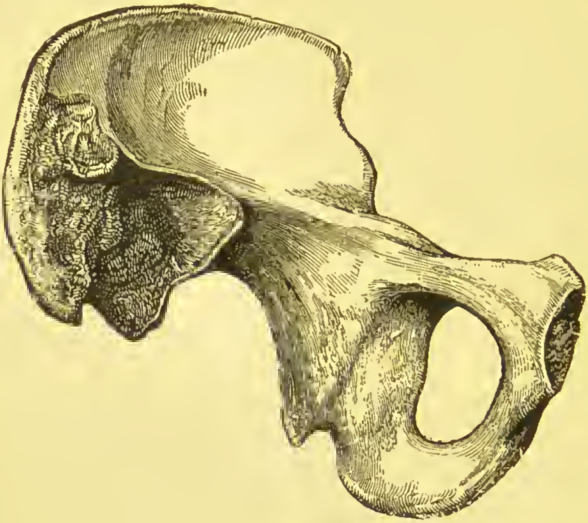

Fig. 1.—Os innominatum.

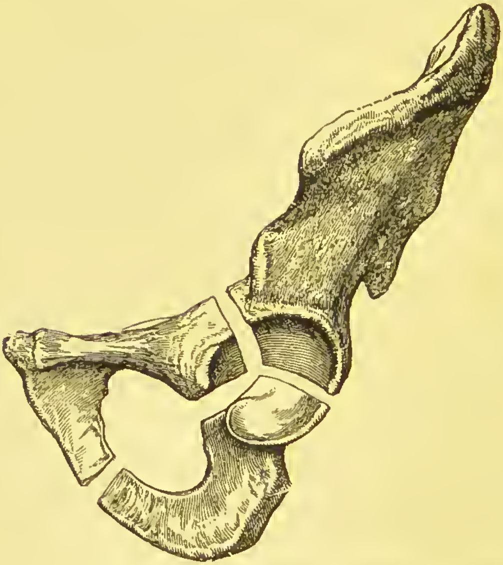

Fig. 2.—Division between the ilium, ischium, and pubes.

As in almost all mammalia the pelvis is made up of four bones ;

two *ossa innominata*, the *sacrum*, and the *coccyx*. Of these, each os innominatum is formed by the union of three principal portions, the *ilium*, *ischium*, and *pubes*. These are separated from each other, generally up to about the age of twenty, by a triradiate or **Y**-shaped piece of cartilage, having its centre at the acetabulum. In addition to the pelvis proper, the last lumbar vertebra has also to be taken into consideration in relation to certain pelvic deformities. The student will be assumed to be fully acquainted with these bones, as described in text-books of anatomy, and those points only which have a special bearing on obstetrics will be here considered.

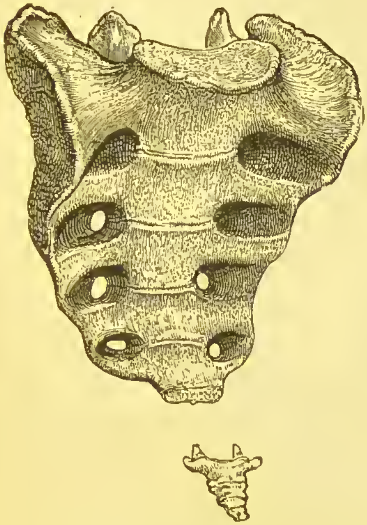
Fig. 3.—Sacrum and coccyx.

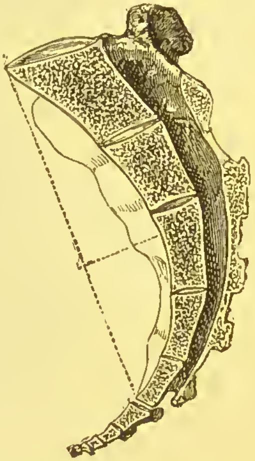
Fig. 4.—Section of sacrum and coccyx.

The Pelvis as a whole.—The formation of the pelvis out of several bones, instead of as a completely ossified ring, serves a triple purpose. 1st. It allows the progressive development which takes place especially about the age of puberty in the female sex. 2nd. By allowing a certain degree of yielding of the joints, it diminishes the risk of fracture. 3rd. It diminishes in some degree the jar transmitted to the trunk and brain from any concussion upon the feet.

The pelvis is divided into two parts by an irregularly oval ring, somewhat approximating towards a heart-shape, which constitutes the pelvic *brim* or *inlet*, and is the part of the bony canal at which deformities most frequently exist, and impediment to the passage of the fœtus most frequently occurs. The upper half, or *false pelvis*, has no direct concern with the mechanism of parturition, and chiefly interests the obstetrician by the fact that, from varieties in its

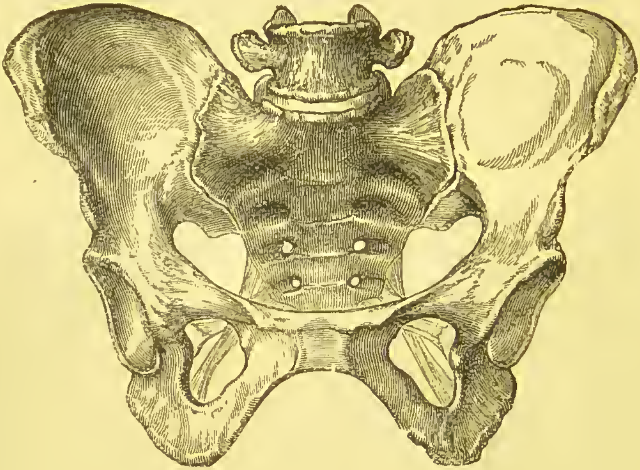

Fig. 5.—Female pelvis, seen from the front.

measurements, inferences may be drawn as to the condition of the true pelvis. The lower half or *true pelvis*, includes the brim itself

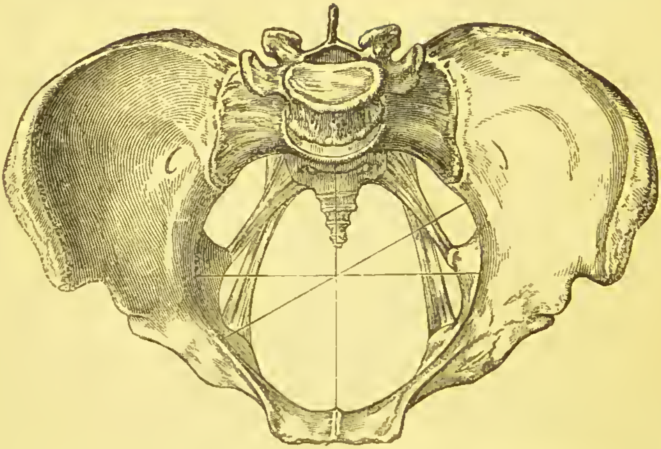

Fig. 6.—Female pelvis, viewed in the axis of the brim. Antero-posterior or conjugate, transverse, and oblique diameters marked.

and all the structures below it. The parts requiring separate consideration are the *brim* or *inlet*, the *outlet*, and the *cavity*, or space comprised between inlet and outlet. The brim is formed by the upper margin of the pubes in front, the ilio-pectineal line of the innominate bone on either side, and the upper and anterior margin and promontory of the sacrum behind. It is to be noted, however, that, although the promontory of the sacrum is usually regarded as forming part of the brim, it generally, in the normal pelvis, lies slightly above the true plane of the brim. Thus the plane of the brim cuts the front of the sacrum in a line situated at a small but variable distance below the promontory; and, if the promontory of the sacrum is regarded as forming part of the curve of the brim, that curve does not lie accurately in one plane. The promontory of the sacrum, even in the normal pelvis, forms a flattened portion in the curve of the brim, but does not actually project inwards. In the commoner varieties of deformity, it does so project inwards, and causes the shape of the brim to resemble an actual heart-shape or kidney-shape. The cavity of the pelvis is bounded by the sacrum and coccyx behind, the pubic bones in front, the inner surface of the innominate bones, with the sacro-sciatic ligaments and the muscles attached to them, at the sides. The outlet is lozenge-shape, and has the tubera ischii at each side, the rami of the ischia and pubes converging to the lower margin of the symphysis pubis in front, and the sacro-sciatic ligaments converging to the coccyx and lower end of sacrum behind. The pelvic brim is sometimes termed the superior strait, the outlet the inferior strait.

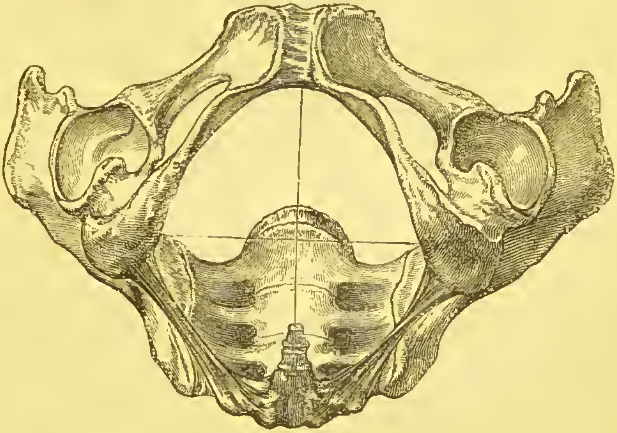

Fig. 7.—Outlet of pelvis. Antero-posterior and transverse diameters marked.

Differences between Male and Female Pelves.—There are important differences between the male and female pelvis, the peculiarities of the latter being necessary to qualify it for its functions in parturition. The bones of the female pelvis are thinner and slighter, and the prominences for muscular attachment less strongly marked. When looked at from the front, the female pelvis is seen to be shallower, wider, and less funnel-shaped, the outlet being relatively larger in proportion to the inlet. As a consequence, both the tubera ischii and the acetabula are much further apart. The latter circumstance causes the woman to have a more undulatory or side-to-side movement in walking than man. The iliac fossæ are also more widely spread out and thus give the

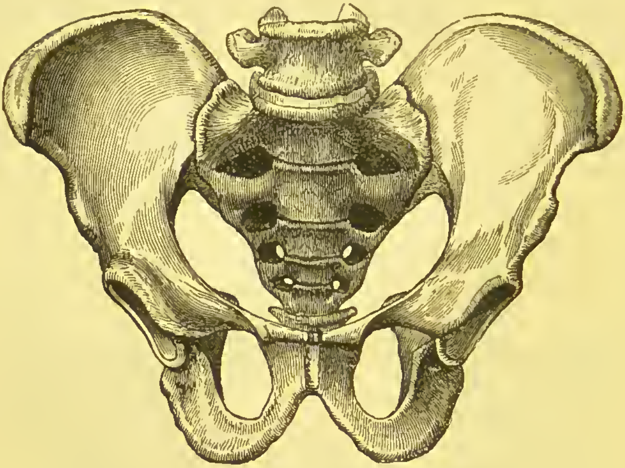

Fig. 8.—Male pelvis, seen from the front.

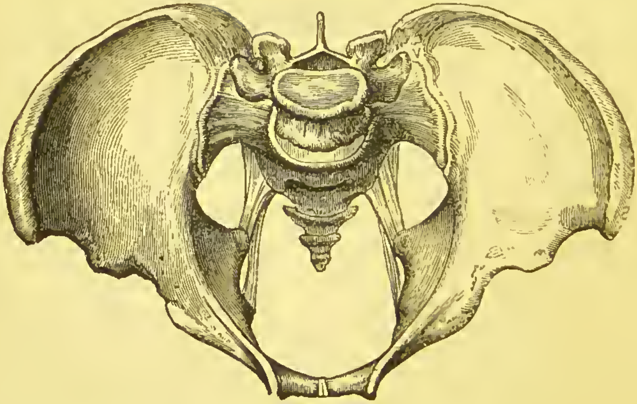

Fig. 9.—Male pelvis, viewed in the axis of the brim.

greater breadth across the hips to woman's figure. A marked difference is the greater width of the pubic arch, which in women is usually greater than a right angle, on the average about 95°; in man less than a right angle, on the average about 75°. The depth of the symphysis pubis is much less in woman, and the sacrum is also less deep as well as broader. The obturator foramina are more triangular, and their vertical diameter less in proportion. The dimensions of the brim are manifestly larger, and more especially the magnitude of the transverse in proportion to the antero-posterior diameter. Looked at from below, the greater size of the outlet of the female pelvis is still more manifest than that of the inlet.

These peculiarities in the female pelvis are connected with the presence in it of the female genital organs, and the larger space which they occupy. In cases in which the uterus and ovaries are imperfectly developed, the pelvis is not unfrequently small, and conversely, in cases of double uterus, the transverse diameter of the pelvis has been found unusually large. There is considerable variety in different individuals in the degree in which the characteristics of the female pelvis, especially the large size of the brim, associated with great length of the transverse compared to the antero-posterior diameter, are developed. There are also differences between different races. In the most intellectual races the pelvis is most fully developed in area, a difference which must be associated with the greater size of the children's heads. The development is greatest in the Circassian race, and affects especially the transverse diameter. In the more savage races, on the contrary, such as Negroes, Hottentots, Bushmen, and Australian Aborigines, not only is the size somewhat less, but the pelvic brim is more round, from relative smallness of the transverse diameter, and thus shows a slightly greater resemblance to the type of the monkey's pelvis, in which the antero-posterior diameter is greater than the transverse (see Fig. 10). The angle of the pubic arch is also generally not so great.

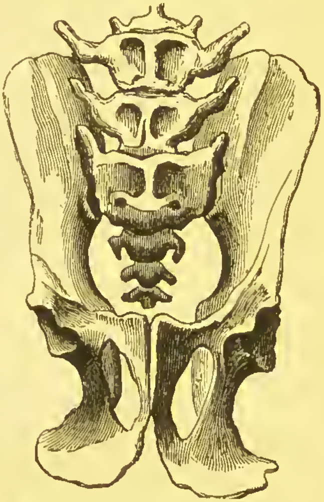

Fig. 10.—Pelvis of a large monkey. (After Humphry.)

Inclination of the Pelvis.—It was formerly supposed that, in the erect position, the plane of the pelvic brim was only slightly inclined to the horizon, that is, that it was nearly in the position which it assumes when the dry pelvis is placed upon a table, resting upon the tip of the coccyx and the tubera ischii. A trace of this error still remains in the term horizontal ramus, applied to the upper ramus of the pubes, whereas in the upright position of the man or woman, this ramus is in reality more nearly vertical than horizontal. It was first shown by Naegele that the plane of the brim, in the erect position, approaches more nearly to the vertical than the horizontal, and he estimated the angle which it makes with the horizon at 60° or more. According to the observations of Meyer, it varies, according to the position of the thighs, from 45° to 100°, and in the usual erect posture, is on an average 54·5°. Taking the angle at 60°, it follows that the height of the promontory of the sacrum above the top of the pubes is, on the average, about $3\frac{3}{4}$ inches. A line passing horizontally backwards through the top of the pubes passes below the tip of the sacrum, and intersects

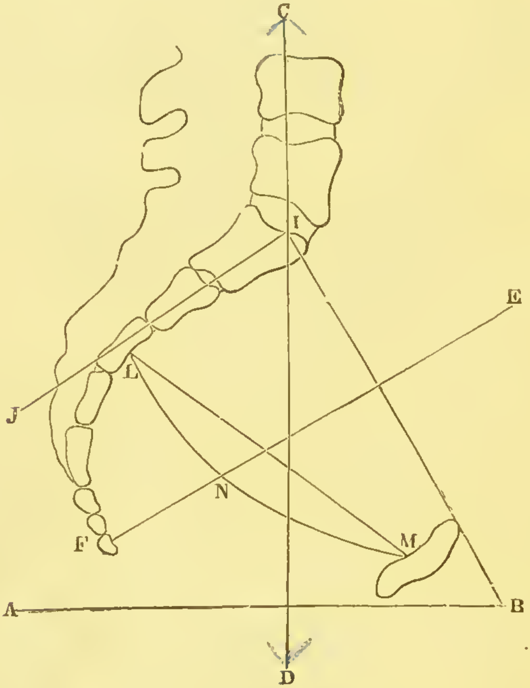

Fig. 11.—Antero-posterior section of pelvis.
A B. Horizon. C D. Vertical line.
A B I. Angle of inclination of pelvic brim to horizon, equal to 60°.
E F. Axis of pelvic brim. L M. Mid-plane of pelvic cavity.
N. Projection on plane of section of apex of ischial spine.
(After Tyler Smith.)

the coccyx. The tip of the coccyx is above the level of the apex of the pubic arch, and a line joining these two points makes an angle of about 10° with the horizon.

In the upright position the vertical line through the centre of gravity of the body passes through a point a little behind the promontory of the sacrum. It corresponds almost exactly with the line C D in Fig 11. For equilibrium to be maintained, when the body is balanced upon the heads of the femora by the aid of gentle muscular action, this vertical line must lie exactly, or almost exactly, in the vertical plane through the points where the acetabula rest upon the heads of the femora. In standing at ease, however, the inclination of the pelvis is slightly diminished, until the strong ilio-femoral ligaments, or one of them, are put upon the stretch, and relieve the muscles in the duty of maintaining the balance. The vertical line through the centre of gravity then falls somewhat behind the vertical plane passing through the acetabula.

In pregnancy, or when any abdominal tumour exists, the pelvic inclination is diminished. The centre of gravity of the body in its new position must be brought over the points of support at the heads of the femora, in order to maintain the balance. This is effected, partly, it is true, by the woman throwing her shoulders backward, and so altering the curve of the spine, but partly also by rotation backward of the whole trunk together upon the heads of the femora. The effect which such rotation through any given angle will have upon the position of the centre of gravity will be greater in proportion to the height of a woman. Hence, in short women, during pregnancy, either the inclination of the pelvis is more diminished than in tall women, or, more frequently, the shoulders are more thrown back, and thus the pregnant condition becomes more manifest.

Articulations of the Pelvis.—There are certain peculiarities about the pelvic articulations which adapt them for the functions of parturition, and accordingly there is a slight difference between the male and female pelvis as regards these joints.

Sacro-iliac Synchondrosis.—The bones are, for the most part, firmly united by the cartilages which cover the opposed articular surfaces. But in the adult woman, and especially in pregnancy, a synovial membrane exists between these surfaces, and a certain small degree of movement is permitted. The nature of this movement is a tilting of the sacrum backward or forward relatively to the pelvis upon a transverse axis passing through the centre of the joint. Thus, by the tilting backwards of the promontory of the sacrum the antero-posterior diameter of the inlet is somewhat increased, and conversely by the tilting backward of its lower extremity there is a slight gain of space at the outlet (see Fig. 12).

The centre of movement is nearer to the promontory than to the tip of the sacrum. Hence the tip describes an arc of a longer circle than the promontory, and the diameter of the outlet is more affected than that of the inlet. It is estimated by Matthews Duncan that, by nutation forward of the promontory, the conjugate diameter of the inlet may be diminished as much as one or even two lines, and that to this diminution corresponds an augmentation of the corresponding diameter of the outlet of probably double the amount.

In this way parturition is facilitated in a perceptible degree. At the early stage of labour the woman is naturally inclined to be up and about, or, if in bed, to lie with the thighs extended; and in these positions the promontory of the sacrum is tilted back, and the pelvic brim gains its greatest dimensions. When, however, the head is passing through the outlet she instinctively draws up her knees and bends her body over them, while the contraction of the abdominal muscles draws the pubes upward. The effect of this is to tilt the promontory forward and the lower end of the sacrum with the coccyx backward, and so give increased room at the outlet. A similar movement has been described as taking place, in lesser degree, by the assumption of a similar position in defecation.

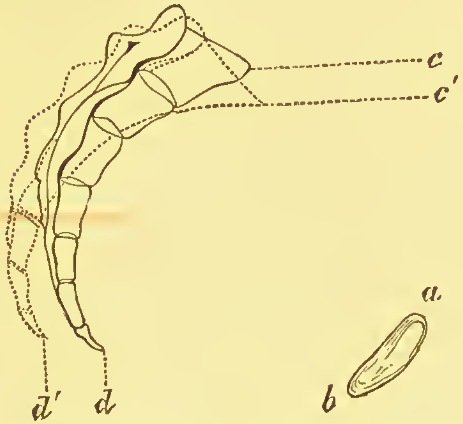

Fig. 12.—Nutation of sacrum during parturition.
a b. Symphysis pubis.
c d. Ordinary position of sacrum.
c' d'. Sacrum in its position of extreme nutation. The tip of the sacrum is carried backward, so as to augment the antero-posterior diameter of the inferior strait. (After Matthews Duncan.)

Symphysis Pubis.—The fibro-cartilage is thicker in front than behind, and towards the posterior part there is a small interspace lined by synovial membrane.

Sacro-Coccygeal Articulation. — The sacrum is joined to the coccyx by a small cartilaginous disc like that uniting the other vertebræ, and occasionally there is a similar disc between the first and second bones of the coccyx. In the adult woman there is a synovial membrane between the sacrum and coccyx, whereby a considerable amount of backward and forward movement is allowed.

Changes in Pelvic Joints during Pregnancy.—In pregnancy the cartilages and fibrous structures become swollen and softened, and the synovial cavities extended, so that the bones are separated slightly further, and the mobility increased. In some cases this process proceeds to a morbid degree, or persists too long after delivery. Walking may thus be painful or difficult from undue mobility at the joints, especially at the symphysis pubis. In some animals the changes in the joints are of more importance than in woman. Thus, in guinea-pigs wide separation takes place at the symphysis pubis in delivery, and in the sow, tilting of the sacrum materially enlarges the pelvic canal.

Mechanical Action of the Sacrum.—A vertical transverse section of the pelvis through its points of support has the form of an arch, both in the standing and the sitting position; these points of support being, in the former case, the acetabula, in the latter, the tubera ischii. There is no mechanical analogy, however, to an arch in architecture, for the opening out of the arch is not prevented by any lateral supports, but partly by the ring of the pelvis being completed at the symphysis pubis, and partly by the strong and wide-spread union of the ilia with the sacrum. Nor has the sacrum any analogy to the keystone of an arch, although, on account of its general resemblance to a wedge, it was formerly compared to one. It has been shown by Matthews Duncan that its action is rather that of a strong transverse beam, which receives the weight of the body at its centre, and transmits it at its extremities to the ilia.

The weight of the body may (by the parallelogram of forces) be considered as made up of two components, one tending to force the sacrum downward and forward in the plane of the pelvic brim (or in the direction I B in Fig. 11, p. 8), the other tending to force it backward at right angles to that plane (or in the direction I J in the same figure). Taking the pelvic inclination at 60°, the latter force is exactly half the weight of the trunk, the former a much more considerable portion of it.*

A section through the centre of the sacro-iliac joint parallel to the brim of the pelvis (Fig. 13, p. 12) shows that the sacrum is broader below than above, and that its general shape, therefore, is just the reverse of such a wedge-shape as would be required to counteract the tendency to displacement in the plane of the brim. A main part of the weight is in fact borne by the posterior sacro-iliac ligaments (*a b*, Fig. 13), by which the sacrum is, as it were, suspended from the posterior crests of the ilia. On looking at the section, however, it will be seen that, near the centre of the joint, there is a space through which the general wedge-shape of the section of the sacrum is reversed. In this way is formed a notch, or what in mechanics is called a "bite," which is of great importance in keeping the bones in place. Its efficacy is increased by the fact that the posterior sacro-iliac ligaments slant inwards, from the ilia to the sacrum (*a b*, Fig. 13), and thus, in proportion to the tension which is put upon them, they draw the ilia more strongly together, and keep the articulating surfaces in closer contact.

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* The exact proportion is sin. 60° or ·866.

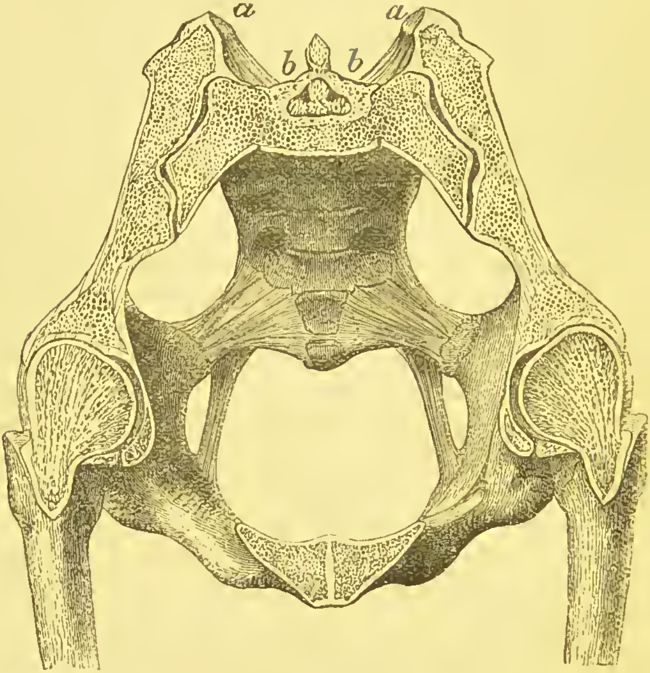

Fig. 13.—Section of pelvis, parallel to the brim, passing through the points where the pelvis rests upon the heads of the femora. *a b*. Posterior sacro-iliac ligaments.

The general wedge-shape of the sacrum does come into play in preventing its displacement downwards and backwards perpendicular to the plane of the pelvic brim. The tendency to separation of the ilia, which its pressure in this direction would produce, is counteracted as before by the slanting direction of the posterior sacro-iliac ligaments which draw the bones more powerfully together in proportion to the strength of the displacing force.

Measurements of the Pelvis.—The dimensions of the canal of the true pelvis may be estimated by drawing any number of imaginary planes at different levels, and ascertaining the diameters of each plane. Of these planes the most important are—first, the plane of the brim; secondly, the median plane of the pelvic cavity, passing through the centres of the sacrum and of the symphysis pubis; and thirdly, the plane of the outlet. The median plane intersects the obturator foramen near its upper part, and the greater sciatic foramen a little above its centre, crossing the ischium above the level of its spine. (See Fig. 15, p. 16, and Fig. 16, p. 18.) The plane of the outlet is generally regarded as drawn through the apex of the pubic arch and the tip of the coccyx. Such a plane, however, has no fixed position, but varies with the position of the coccyx; and, further, except in case of ankylosis of the coccyx, it is the plane of outlet of the fixed bony pelvis, terminating at the lower extremity of the sacrum, which determines the limit of size of the body which can pass out. For the coccyx can be pressed backward until the antero-posterior diameter measured from its tip exceeds that measured from the lower end of the sacrum. Moreover, the coccyx being thus moveable, and virtually endowed with elasticity in virtue of its connection with the perineum and its muscles, any influence which it exercises upon the progress of labour is comparable rather to that exercised by the soft parts of the perineum, and differs totally from the resistance of the rigid portion of the pelvis. Hence it appears preferable, with Tyler Smith, to regard the plane of the outlet as that drawn through the apex of the pubic arch and the lower extremity of the sacrum (M N, Fig. 16, p. 18). Such a plane is inclined about 16° to the horizon, assuming the inclination of the pelvic brim to be 60°, while a plane drawn through the tip of the coccyx is inclined only about 10°, or less, according to the position of that bone.

Diameters of the Pelvis.—In each plane three diameters are generally described, the antero-posterior, the oblique, and the transverse (see Fig. 6, p. 4). At the brim the term *conjugate* is frequently applied to the antero-posterior diameter. The name is taken from that given to the smallest diameter of an ellipse, and should not therefore be extended, as it sometimes is, to the antero-posterior diameters in the cavity, and at the outlet, since these are not the smallest in their respective planes. The oblique diameters at the brim are drawn from a point on the ilio-pectineal line a little in front of the sacro-iliac joint on either side to a point corresponding with the ilio-pectineal eminence. It is to be noted that the *right oblique diameter* (R O) *is that which starts from the right sacro-iliac joint, and the left oblique* (L O) *that which starts from the left* *sacro-iliac joint.* Some confusion has arisen from the fact that some French authors have used the terms in just the opposite sense, naming each oblique diameter from it anterior instead of from its posterior extremity. Taking the average of a large number of normal pelves, the following may be given as the standard measurements, taking the nearest quarter of an inch, and avoiding decimals :—

	Antero-posterior.	Oblique.	Transverse.
Brim	$4\frac{1}{4}$	$4\frac{3}{4}$	$5\frac{1}{4}$
Cavity	$4\frac{3}{4}$	$(5\frac{1}{4})$	$4\frac{3}{4}$
Outlet	$4\frac{1}{2}$	$(4\frac{1}{2})$	$4\frac{1}{4}$

The oblique diameters at the cavity and the outlet are enclosed in brackets, as of comparatively little importance, since their length is uncertain, not being measured between bony points.

The rhomboidal opening presented by the pelvis including the coccyx, when looked at from below (Fig. 7, p. 5), does not lie in one plane, the tuberosities of the ischia being on a lower level than the line joining the apex of the pubic arch to the tip of the coccyx. It may be regarded as made up of two triangles, one side being common to the two, namely, the transverse diameter between the tuberosities of the ischia, the apex of one triangle being the apex of the pubic arch, of the other the tip of the coccyx.

The following are average measurements :—

Between ischial tuberosities	$4\frac{1}{4}$
Antero-posterior measured to tip of coccyx . .	$3\frac{1}{2}$
This may be increased when the coccyx is pushed backward in parturition to . . .	$4\frac{1}{2}$—5

It will be observed that the transverse diameter is progressively and considerably diminished in passing from the brim towards the outlet, the effect of which is obvious on looking at a vertical section of the pelvis from side to side perpendicular to the plane of the brim (Fig. 14). The diminution is chiefly due to a slightly marked line of elevation running from the brim at about the position of the ilio-pectineal eminence downward and backward to the ischial spine, at which point the transverse diameter is the smallest of all the diameters of the normal pelvis, being only four inches, or very little more. On looking at a lateral view of the pelvis from within (Fig. 15, p. 16), it will be seen that this line divides the lateral wall into an anterior and posterior part. Before and behind this elevated line are two smooth inclined planes, the former looking slightly forward, the latter slightly backward. These are the *anterior and posterior inclined planes of the ischium.* This narrowing of the lateral dimensions of the pelvis from above downwards has a considerable influence on the rotations of the fœtus in parturition; and the pressure of the inclined planes comes also into play, although, by some authors, an exaggerated importance has been attached to them.

The antero-posterior diameter becomes considerably increased as it is traced downward from the brim into the cavity of the pelvis, but is diminished again rather suddenly when the inferior strait or plane of outlet of the true rigid pelvis is reached. Beyond this point it is again somewhat increased, owing to the mobility of the coccyx, supposing this bone to be pressed backward to its fullest extent. The diminution which the antero-posterior diameter undergoes at the inferior strait does not, however, alter the general result, namely, that the transverse diameter is the longest at the brim, the oblique in the cavity, and the antero-posterior at the outlet. It will be seen hereafter that this fact is of great importance in determining the movement of the fœtal head, the longest diameter of which rotates as in a screw, following the longest diameter of the pelvis.

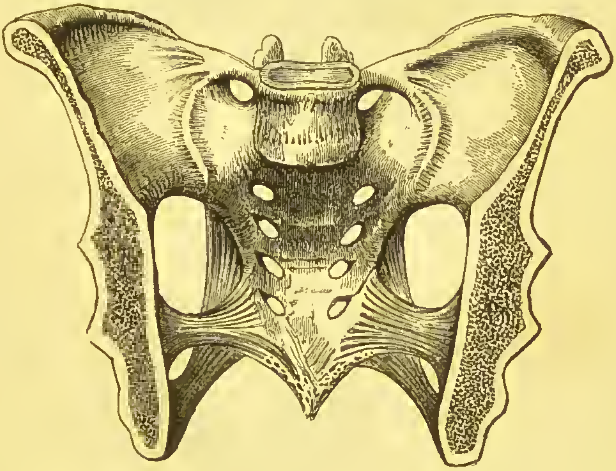

Fig. 14.—Section of pelvis, side to side; perpendicular to plane of brim.

The right oblique diameter at the brim is, as a rule, slightly longer than the left. Two causes may contribute to this result; first, the greater use of the right leg, leading to a greater inward pressure at the right acetabulum, and a consequent relative shortening, in development, of the left oblique diameter, ending at that acetabulum; secondly, a congenital asymmetry, which runs throughout the vertebral column, including the cranial bones, and in virtue of which that column has a slight tendency towards a spiral arrangement instead of being perfectly straight. It is doubtful, however, whether the right leg is generally stronger than the left; and whether it is not rather the left leg which corresponds to the right arm with which it moves synchronously.

Alterations of diameters by soft parts.—The diameters as given above are measured in the dry pelvis, and the presence of the soft parts introduces modifications of some importance, especially at the pelvic brim. In general the soft parts diminish each available diameter about $\frac{1}{8}$ inch, except when the uterine wall intervenes between the presenting part and the pelvis, in which case the diminution may be much greater. At the brim, however, the projections of the psoas and iliacus muscles lessen the transverse diameter about $\frac{1}{2}$ inch. In the clothed pelvis, therefore, the oblique diameter at the brim, instead of being smaller than the transverse, is about equal to it.

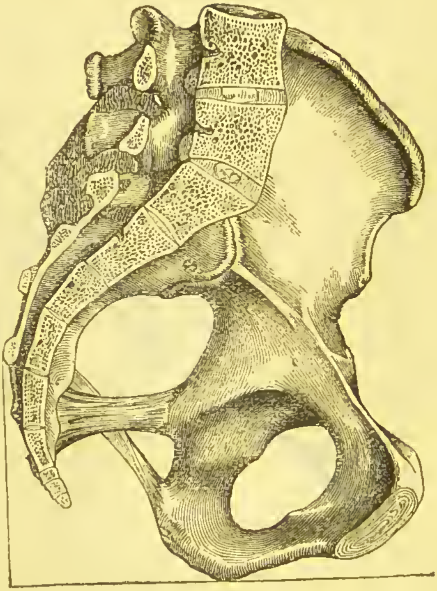

Fig. 15.--Lateral view of pelvis from within, showing the inclined planes of the ischium.

Other Measurements.—Besides the diameters already given, there is another which has considerable practical importance, because it can readily be ascertained in the living woman. This is measured from the apex of the pubic arch to the promontory of the sacrum, and is called the diagonal conjugate (C D), or sacro-subpubic diameter

(E N, Fig. 16, p. 18). In the normal or slightly contracted pelvis it is about two-thirds of an inch longer than the true conjugate, and therefore measures normally 4·90 inches. Another diameter commonly given is the sacro-cotyloid diameter measured from the promontory of the sacrum to a point corresponding to the acetabulum on each side. It measures normally $3\frac{1}{2}$ inches. The cavity of the pelvis is much deeper posteriorly than anteriorly, the depth from the promontory to the tip of the sacrum being $3\frac{3}{4}$ inches, or to the tip of the coccyx, $4\frac{1}{4}$ inches, while the depth of the symphysis pubis is $1\frac{1}{2}$ inches.

External Measurements.—The external measurements of the pelvis are only of significance from the fact that inferences may be drawn from varieties in them with regard to the magnitude of internal diameters. The following are average measurements :—

	Inches.
Between anterior-superior spines of ilia (Dist. Sp. Il.)	10
Between widest part of iliac crests . (Dist. Cr. Il.)	$10\frac{3}{4}$
External conjugate (C. Ext.) between spine of last lumbar vertebra and upper part of symphysis pubis	$7\frac{1}{2}$

Axis of the Pelvis.—By the axis of the pelvis is meant an imaginary line indicating the course taken by the centre of the fœtal head as it passes through the genital canal. This course not being precisely defined, various modes have been given for drawing the axis of the pelvis. Thus the centre of the head was supposed to move in what was called the circle of Carus, a circle having its centre at the upper margin of the pubes, and a radius equal to half the conjugate diameter of the brim. But the inner surface of the sacrum is almost straight in vertical section so far as the junction of its second and third bones, and the inner surface of the pubes is also nearly straight, diverging only at a small angle from the direction of the surface of the sacrum. The centre of the head, therefore, in the first part of its course, descends almost in a straight line, as through a cylinder, until it is low enough for the head to meet the resistance of the curved portion of the sacrum, forming part of the pelvic floor. Its course, therefore, has no resemblance to the arc of a circle, neither does it resemble a parabola, to which it has been compared, for the two arms of a parabola tend towards directions parallel to each other, if produced far enough.

The following construction for drawing the pelvic axis will give a line closely approximating to the path of the centre of the fœtal head. Through the promontory of the sacrum draw a line E F (see Fig. 16, p. 18), not to the absolute summit of the symphysis pubis, but to the nearest point of the symphysis. This line represents the smallest diameter through which the fœtus has to pass at

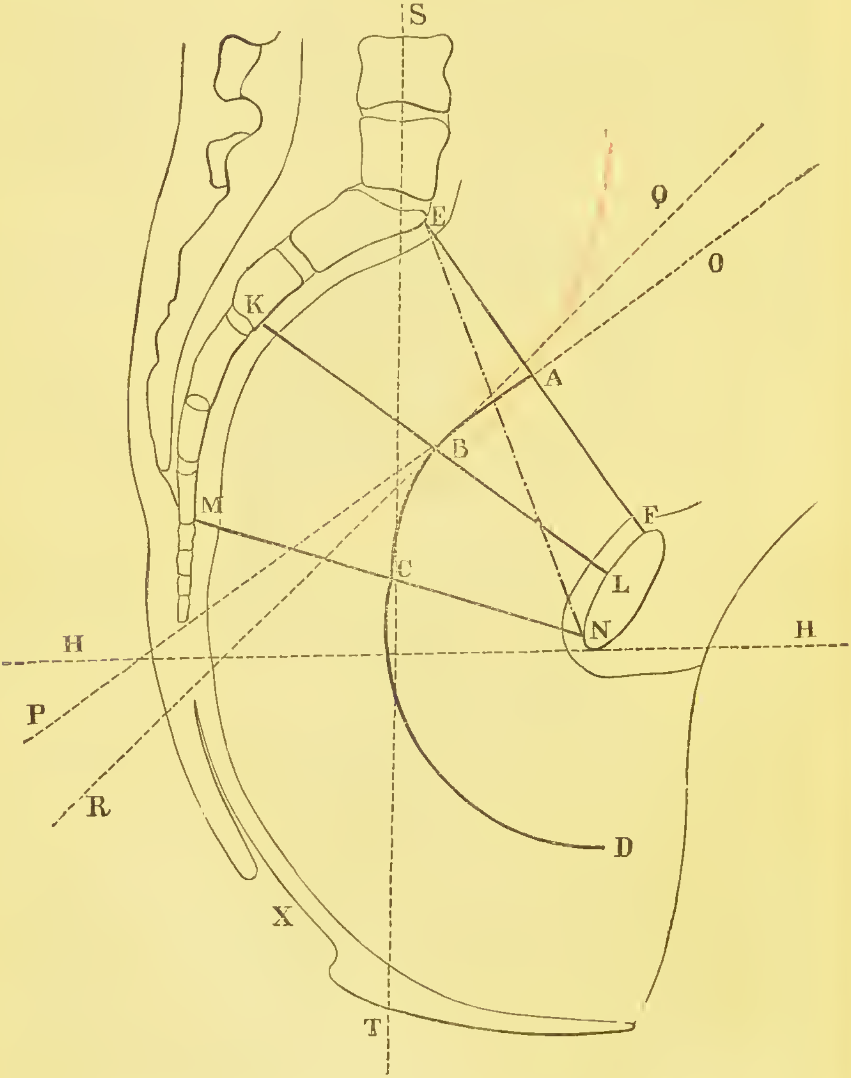

Fig. 16.—Diagram showing axis and planes of pelvis. A B C, axis of pelvis; C D, axis of developed canal of soft parts; X, anus as distended in parturition; E F, plane of brim; K L, mid-plane of cavity; M N, plane of outlet; O P, axis of brim; Q R, axis of mid-plane; S T, axis of outlet; H H, horizon; E N, diagonal conjugate or sacro-subpubic diameter.

the brim, and therefore most rightly deserves the name of the true conjugate diameter. It is sometimes called the obstetric true conjugate diameter, to distinguish it from a line drawn to the absolute summit of the symphysis, as in Fig. 11 (p. 8). The plane passing through E F perpendicular to the plane of the figure is, for practical purposes, the plane of the pelvic brim. Similarly, if M N be drawn from the tip of the sacrum to the nearest point at the bottom of the symphysis pubis, M N is the smallest antero-posterior diameter at the inferior strait, and the plane passing through M N perpendicular to the plane of the figure, is the plane of the pelvic outlet.

From the point in front of the pubes where E F and M N meet, let any number of radii be drawn intersecting the pubes and the sacrum, and let a line A B C be drawn, passing through the centres of all those portions of the radii which are intercepted between the inner surfaces of the pubis and sacrum. The line A B C will be the axis of the bony pelvis. The upper half of it, A B, will be almost a straight line, since the upper half of the anterior face of the sacrum is nearly straight. If K L be a radius midway between E F and M N, the plane passing through K L perpendicular to the plane of the figure will be the mid-plane of the pelvic cavity.

The construction may be completed in the following manner for the variable portion of the genital canal. Suppose the coccyx to be pushed back as in parturition, and the soft part of the canal to be dilated to the full expansion reached as the fœtal head is passing through it. The curve of the posterior wall of the canal will thus be an arc of a circle having its centre near the lowest point of the symphysis pubis, and the axis of the canal of soft parts, including the coccyx, will be an arc of a circle C D, having the same centre and half the radius. At C there is a point of discontinuity between the axis of the bony pelvis and that of the canal of soft parts. At this point the centre of the head slightly changes its direction of movement on passing the inferior strait, having just previously been compelled to approach nearer to the pubes, on account of the progressive diminution of the antero-posterior diameter.

Axes of the several Planes of the Pelvis.—It has been usual to regard the axis of each plane as a straight line drawn at right angles to that plane through its centre. Such a line, however, has no practical significance or use. What we want to know is the direction in which the centre of the head is, or ought to be, advancing, when that centre lies in any given plane of the pelvis. This direction will be given if we define the axis of any plane as the tangent to the curved axis of the pelvis at the point where it cuts that plane. This is the same thing as the straight line joining the centres of two very closely adjacent planes, and it therefore necessarily gives the direction of motion of the centre of the head. As thus defined, the axis coincides with the line drawn at right angles to the plane at the brim, but at other parts, especially towards the inferior strait, this is not precisely so. In figure 16, O P is the axis of the brim. Q R, the axis of the mid-plane, is inclined only slightly to the axis of the brim, on account of the slight curvature of A B, the upper part of the pelvic axis. S T, the axis of the outlet, which indicates the line of movement of the centre of the fœtal head as it approaches the outlet, differs appreciably from the straight line drawn at right angles to the plane of the outlet, and is nearly coincident with the vertical axis of the woman.

The Pelvis in Infancy and Childhood.—In infancy the pelvis is very small, even in proportion to the size of the child, and

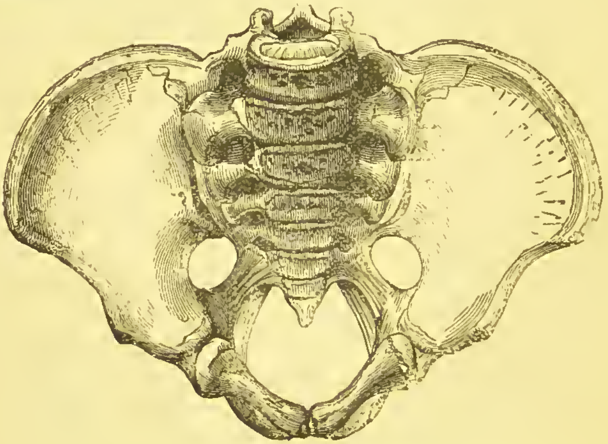

Fig. 17.—Infantile pelvis viewed in the axis of the brim.

thus the organs afterwards contained in the pelvis are, in the infant,
partially in the abdomen. The prominence of the abdomen noticed
in early life is thus accounted for. Besides its small size, the pelvis
of the infant differs in shape from that of the adult, and departs less
widely from the type of pelvis seen in animals (see Fig. 17). The iliac
fossæ are flatter and less spread out, more upright, and their surfaces
3 look more forward. The maximum distance between the iliac crests
4 is hardly greater than that between the anterior-superior spines. The
5 sacrum is narrower in proportion than in the adult pelvis, its alæ
being less developed, and consequently the preponderance of the 6
transverse over the conjugate diameter is less marked. The pelvis is
7 funnel-shaped, becoming smaller towards the outlet in the female
sex as well as in the male. The curve of the sacrum, in antero- 8
posterior section, is very slight, and the sacro-vertebral angle is less
9 than in the adult, so that the anterior surface of the sacrum looks

more forwards and not so much downwards. The transverse con- 10
cavity of its anterior surface is greater than in the adult, while it is
less deeply sunk between the iliac bones in the direction of the 11
coccyx. The curvature of the ilio-pectineal lines is slighter. The 12
pubic arch forms a more acute angle, and the tubera ischii are 13
relatively nearer together than in the adult. The three portions of
the innominate bone, separated by a triradiate or Y-shaped piece of
cartilage, having its centre at the acetabulum, are not united into a 14
solid bone till about the twentieth year, an arrangement which permits the prolonged enlargement of the pelvis by growth. It has generally been said that there is little or no distinction between the male and female pelvis in fœtal life and childhood, but, according to Fehling's researches, the distinctions of sex are manifested much earlier than has been supposed, even at the fifth month of fœtal life. The special characters of the female pelvis, especially its relatively large size, are not however fully manifested until the time of puberty is drawing near. About this time a specially rapid growth takes place in the female, except in those cases in which there is congenital deficiency of uterus and ovaries. This is one of the facts which show that the development of the pelvis depends largely upon the original forces of growth, and not merely upon mechanical influences.

Development of the Pelvis.—The changes in shape which the pelvis undergoes during growth are brought about partly by the development of the several bones, and partly by the action of mechanical forces. It is of special importance to study carefully the action of these influences in the development of the normal pelvis, for if this be once thoroughly understood, the mode in which all the forms of distorted pelvis result from modifications of these influences will present no difficulty. The chief influence depending directly upon development arises from the relatively rapid growth, in the female sex, of the wings of the sacrum, whereby the transverse diameter gains its great magnitude. The most important mechanical influence is exerted by the weight of the body transmitted through the sacrum, from the effect of which the bones become gradually moulded in the course of years. The pressure and tension of muscles and ligaments have also considerable influence.

Changes in the Sacrum.—The vertical line through the centre of gravity of the body passes nearly through the promontory of the sacrum, and therefore in front of the centre of the sacro-iliac joint (C D, Fig. 11, p. 8). The effect of the weight therefore tends to rotate the promontory of the sacrum forward and downward upon a transverse axis through the centre of the sacro-iliac joint. The lower extremity of the bone would be tilted back in corresponding degree, but for the tension of the sacro-sciatic ligaments. The effect of the two forces acting in conjunction is that the curvature of the sacrum, in antero-posterior section, is increased, while the sacro-vertebral angle becomes more acute, and the upper part of the anterior surface of the sacrum approaches nearer to the horizontal. Besides this, each of the two components of the body weight, one acting perpendicular to the pelvic brim, the other in the plane of the brim, has an effect upon the sacrum. The first causes it to sink deeper downward and backward between the ilia, so that the promontory approximates more nearly than before to the plane of the brim. (Compare Fig. 17 with Fig. 6, p. 4.) The second and larger component causes it to sink slightly towards the centre of the brim, so that the posterior crests of the ilia stand out further behind it. It also, through yielding of the bone, diminishes its curvature in transverse section, and thus flattens that part of the circumference of the brim formed by the sacrum. (See Fig. 18.) This effect is increased if the bone is unduly soft, as from rickets, and the promontory then becomes an actual projection inwards into the brim.

Changes in the Lateral Pelvic Wall.—It has been already explained that a main part of the weight of the body is suspended from the posterior crests of the ilia by the posterior sacro-iliac ligaments (see pp. 11, 12). Its effect upon the shape of the brim may be studied by examining a section parallel to the brim, through the points of support of the acetabula upon the heads of the femora, a section which passes also nearly through the centre of the sacro-iliac joint and its posterior ligaments. (See Fig. 13, p. 12, and Fig. 18.)

The innominate bone (*ade*, Fig. 18), hinged upon the sacro-iliac joint (*c*), forms a lever, whose fulcrum is the joint *c*. The posterior extremity (*a*) of the lever is drawn forwards and inwards through the posterior sacro-iliac ligaments (*ab*) by that component of the body-weight which acts parallel to the brim. The anterior end (*e*) of the lever would therefore be tilted outward, on an axis perpendicular to the brim passing through the fulcrum *c*, but that it is held inward by the symphysis pubis. As it is, the bone is gradually moulded and its curvature increased, so as to enlarge the transverse diameter of the pelvis.

In Fig. 18 is shown diagrammatically the change of shape produced by the body-weight in the advance from infancy to maturity. The actual change, as shown in the figure, is exaggerated, according to modern views as to the true shape of the infantile pelvis, since the transverse exceeds the conjugate diameter even in infancy. Comparing B with A, it will be seen that in B the sacrum has become flattened, and has sunk deeper between the ilia. The lateral walls of the pelvis have become more curved, and, in consequence, the transverse diameter has become relatively greater.

Effects of the Pressure of the Femora.—The tilting outward of the anterior end of the lever is resisted, not only by the completion of the pelvic ring at the symphysis pubis, but by the inward pressure of the heads of the femora at the point *d* (Fig. 18). So far indeed as this pressure is the reaction to the weight of the body, it acts vertically upwards (P, Fig. 18). This is evident if the equilibrium of the leg is considered. The resistance of the ground, by which the weight of the body is supported, acts vertically upwards. For equilibrium this line of action must coincide with the line in which the weight of the body is transmitted downward to the head of the femur. It therefore tends to thrust the acetabulum *d* not inward but outward. For the projection of its direction on the plane of Fig. 18, being a vertical line (P), will fall outside the sacro-iliac joint or fulcrum *c*. The force P will, therefore, tend to rotate the lower end of the innominate bone, or lever *ade*, outward.

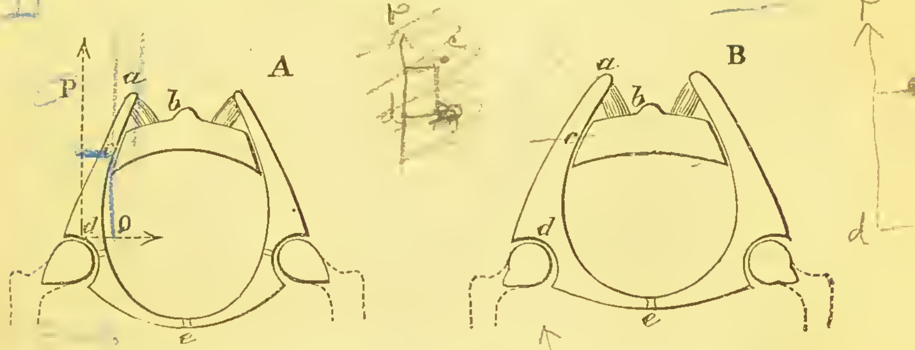

Fig. 18.—Diagram to illustrate the change of shape in the pelvis. The figures are supposed to be sections parallel to the plane of the brim, passing through the points where the pelvis rests on the heads of the femora, like the actual section shown in fig. 13, p. 12.

A. Infantile pelvis.
B. Mature pelvis.
ab. Posterior sacro-iliac ligaments.
c. Sacro-iliac synchondrosis.
d. Point at which pelvis rests on head of femur.
e. Symphysis pubis.
P, Q. Components of pressure of head of femur.

The pressure of the head of the femur has, however, also a horizontal component Q, acting inward at the point *d*. This is due to the horizontal component of the tension of the muscles which slant inward from the femur to the pelvis. It is to be observed also that the perpendicular from the fulcrum *c* (Fig. 18) on the direction of the force Q is much greater than that i.e. the perpendicular from the fulcrum c on the direction of P. The force Q has therefore in this respect a mechanical advantage in leverage over the force P. Inward pressure at the acetabulum is also produced in lying on the side. It would be impossible to calculate *à priori* whether on the whole the inward or outward leverage would preponderate. But experience shows that the

∴ the lever arm, being [illegible]

inward leverage does actually preponderate. This is proved by the fact that, in persons who sit much and stand or walk little, as, for instance, children who suffer severely from rickets, the pelvis becomes relatively wider, from diminished action of the pressure of the femora. It is also proved especially by two rare forms of pelvis. The first is that in which the legs are congenitally absent, but the woman is able to sit upon the tubera ischii. The second is that of the so-called congenital dislocation of both femora, really a malformation, in which no acetabula are developed, but the heads of the femora rest on the outside of the expansions of the ilia. In both these forms of pelvis, the transverse diameter is relatively large, in consequence of the absence of the pressure of the femora at the acetabula.

Since therefore the tension of the sacro-iliac ligaments (*ab*, Fig. 18) is resisted both by the inward thrust at *d* and by the tension at *e*, the ilium is the portion of the innominate bone which is most strongly acted upon between the counteracting forces, and thus it is at the posterior part of the lateral wall between *c* and *d* that the curvature of the brim is most increased. The effect extends also to the crest of the ilium, which gains in this way that curvature, owing to which the maximum transverse diameter (Dist. Cr. Il.) comes to exceed the distance between the anterior-superior spines (Dist. Sp. Il.). The inward pressure of the femora is not in itself, without the effect of the junction at the symphysis pubis, sufficient to counteract the tilting outward of the anterior end of the lever, as is proved by the fact that the acetabula do actually become relatively further apart, and the anterior half of the pelvic ring has its share in the moulding produced.*

The ilium alone has been regarded as forming the lever, and termed the "sacro-cotyloid beam." All the parts of the innominate bone, however, react upon each other, even though the union between them is only by cartilage, as is proved by the fact, already mentioned, that the development of the curvature of the brim takes place even in the absence of an acetabulum.† There is another reason why it is mechanically unsound to regard the ilium alone as the lever. For, since there is more or less rigid union between ilium and pubes, the action between the two cannot be reduced to a single resultant force but only to a force and a couple, while the direction of the couple cannot be determined. But, at the point *e*, where the two pubic bones are united, it is obvious from symmetry that the action between the two in the standing position is reduced to a single horizontal force, and that the couple vanishes.

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* For a discussion of the effect of the pressure of the femora, see Champneys, Obstet. Trans., Vol. XXV.

† Matthews Duncan, in his able discussion of this subject, committed one error, when he assumed that the direction of the neck of the femur indicates the direction of the resultant pressure of the head of the femur upon the pelvis ("Researches in Obstetrics," p. 106). There is no reason why it should indicate this direction, since the force is transmitted just as if the femur formed a straight line, and that it does not do so is proved by the change in the direction of the neck of the femur which sometimes occurs in old age, when its inclination to the vertical becomes more obtuse. This shows that the average direction of the resultant pressure of the pelvis upon the head of the femur is not in the line of the neck, but more nearly vertical. The same conclusion may be arrived at *à priori*. The neck of the femur forms an angle of from 60°

The leverage action in widening the pelvis being dependent upon the component of the body-weight which acts parallel to the plane of the brim, it follows that the effect is increased with any increase of the inclination of the brim and the converse. Hence we get a general principle which it is of great importance to remember in all pelvic deformities. *Any deformity which increases the inclination of the brim, tends to produce a relatively great, and any deformity which diminishes it to produce a relatively small, transverse diameter.*

Effects of Sitting.—In sitting the reactions to the weight of the body act vertically upwards through the tubera ischii. The projections of these vertical lines upon the plane parallel to the brim through the centres of the sacro-iliac joints pass outside those joints, just as the line P does in Fig. 18, p. 23, the tubera ischii being further apart than the sacro-iliac joints. Hence the effect of the pressure tends to rotate the anterior end of the lever formed by the innominate bone outward. In persons, therefore, who cannot stand or walk during the age of development, but sit a great deal, the pelvis is generally wider than normal. For the body-weight tends to widen the pelvis by leverage, as in standing, although in somewhat less degree, on account of the diminished pelvic inclination; and this tendency is assisted by the pressure on the tubera ischii, instead of being counteracted in some measure by pressure on the acetabula.

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to 75° with the vertical. If this were the direction of the resultant pressure, it would follow, from the parallelogram of forces, that the horizontal component, due to muscular action alone, would be considerably greater than the vertical component, the reaction to the weight of the body. And since the horizontal component is itself only a fraction of the whole muscular force, it would be necessary that the muscular force in action should be considerably more than double that required to suspend the body, not including the legs, and this would be clearly an absurd conclusion. Moreover, in running or jumping, it is the vertical component of the pressure which is increased by the effect of momentum. We may infer that the direction of the resultant pressure is much nearer the vertical than is that of the neck of the femur, and that the angle of the latter is adapted simply to facilitate the movement of the joint, and the arrangement of the muscles round it. It would seem, therefore, that Matthews Duncan attached too much importance to the inward pressure of the heads of the femora, and too little to the tension of the anterior half of the pelvic ring in counteracting the tendency to outward rotation of the anterior ends of the sacro cotyloid beams.

Again, since the vertical line through the tubera ischii passes outside a line joining the centre of the symphysis pubis and the sacro-iliac joint, the pressure on the tuber tends to rotate the lower part of the innominate bone outward upon this line as axis. Movement of the whole bone being resisted by the ligaments, the ischia become bent somewhat outwards, and the distance between their tubera relatively wider, as the pelvis grows. The action of the muscles passing from the ischium and from the lower ramus of the pubes to the femur also tends to draw the ischium outwards, and to widen the pubic arch. The same forces which widen the distance between the tubera ischii also counteract the tendency which the tension of the lesser sacro-sciatic ligaments would otherwise have to approximate the spines of the ischia.

Effects of Muscular Action.—The plane of the abdominal muscles attached to the anterior half of the pelvic ring is inclined backward in reference to the axis of the brim (see Fig. 69). Of these muscles, the recti are the most powerful. Thus, the traction force exercised by these muscles has a component acting in the plane of the brim and tending to pull the pubes backward toward the sacrum, and thus flatten the pelvic ring from before backward and spread it out laterally. This force aids the effect of the body-weight in promoting the transverse development of the pelvis. It is probably due to the same force that, in intra-uterine rachitis, before the body-weight can have any influence, the characteristic rachitic shape of brim is produced. The psoas and iliacus muscles also tend to draw the superior half of the pelvic ring toward the inferior, and so to flatten the pelvis.

The change of shape of the iliac fossæ, by which they become more curved and more hollow and look more upwards than in infancy, is promoted by the traction of the muscles attached to them, especially the glutei and sartorius, as well as by the leverage exercised on the ilia by the posterior sacro-iliac ligaments.

The doctrine that the weight of the body is the most important of the influences determining the normal development of the adult out of the infantile pelvis, and also the production of certain forms of pelvic deformity, especially of the rachitic pelvis, is supported by Litzmann,* Matthews Duncan,† and Schrœder.‡ On their authority it has obtained wide acceptance. Kehrer,§ however, has argued that, because many of the changes characteristic of rickets have been found in congenital cases, when the body-weight can have had no influence, the action of the muscles must be the most important element in the case. Fehling * also contends against the doctrine of the influence of the body-weight in the normal development, and in the production of the rickety pelvis; and, as to the formation of the latter, attaches the chief importance to arrest or disturbance of development.

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* Die Formen des Beckens. Berlin. 1871.

† Researches in Obstetrics. Edinburgh. 1868.

‡ Lehrbuch der Geburtshülfe. Bonn. 1881.

§ Zur Entwickelungsgeschichte des Rachitischen Beckens. Arch. für Gynæk. Band V. 1872.

It must be admitted that both the forces of growth and the action of muscles are of much importance, and that Matthews Duncan and Schrœder have attached too exclusive an influence to the leverage action of the "sacro-cotyloid beam." But it does not follow that, because in intra-uterine rachitis, when the bones are still more yielding than in rickety children, the action of muscles and other pressures are sufficient to produce many of the usual rachitic changes, the effect of the body-weight is not a very important or even the predominant influence after birth.

The following are the chief arguments proving the important influence of the body-weight.

(1.) That all the changes which the body-weight and the resistances it calls out might be expected to produce in the pelvis, do actually occur in the progress from infantile to adult life. These are the changes already described (pp. 20—25), namely, relative increase of the transverse diameter, rotation of the sacrum on a transverse axis, with corresponding increase of its curvature in antero-posterior section and diminution of the sacro-vertebral angle, flattening of the sacral curve in transverse section, sinking of the sacrum deeper between the ilia in the direction of the coccyx, separation of the tubera ischii, widening of the pubic arch, and general relative increase of the pelvic outlet. Fehling, indeed, contends that conclusions drawn from dried fœtal pelves are unsafe, on account of the change of shape which occurs in drying. He declares that the transverse expansion of the brim is present even at the third month of fœtal life, and that sexual differences are plainly seen even at the fifth month. Hence he argues that the traction of the ilio-sacral ligaments is far less important than Matthews Duncan supposed, and that the transverse expansion of the fœtal pelvis depends upon original growth. It may be allowed that Fehling has shown that the supposed differences of the fœtal and infantile pelvis from the adult have been exaggerated, and that the importance of the influences of original formation has been under-estimated; but almost all fœtal pelves do show in some degree characters corre-

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* Die Form des Beckens beim Fötus und Neugeborenen. Arch. für Gynæk. Band X. 1876. Die Entstehung der Rachitischen Beckens. Arch. für Gynæk. Band XI. 1877.

sponding to the changes enumerated above (see Fig. 17, p. 20), and it is impossible that any changes in drying should always occur in the same direction.

(2.) That in rachitic softening of the bones all the changes are exaggerated.

(3.) That in the various forms of pelvic deformity, whenever the pelvic inclination, and therefore also the component of the body-weight acting in the plane of the pelvis, are increased, the conjugate diameter is relatively diminished; whenever these are diminished (as in the kyphotic pelvis), the conjugate diameter is relatively increased.

(4.) That in the malacosteon pelvis (see Chapter XXIX.), which has originally been normally developed, and which is changed by mechanical influences, the change of shape is obviously due mainly to the body-weight, together with the pressures on the acetabula and tubera ischii.

(5.) That the formation of the oblique pelvis of Naegele, in which one sacro-iliac synchondrosis is anchylosed (see chapter on Contracted Pelvis), can only be explained by the leverage of the innominate bone being called into action on one side only, and so producing the usual curvature of the brim on that side only, while the opposite side remains nearly straight.

CHAPTER II.

OVULATION AND CONCEPTION.

Development of the Ovules.—Every ovule in the adult ovary has its origin from a portion of the epithelium lining the pleuro-peritoneal cavity of the embryo. While the general epithelium of this cavity is flattened, that covering the Wolffian body is cylindrical. A thickening of this epithelium is formed at one point, and this constitutes the earliest trace of the ovary. In the chick it appears at about the fourth day of incubation. The connective tissue beneath also proliferates, and eventually forms the vascular and fibrous stroma of the ovary, while the epithelial cells are destined to form the ovules, and, according to some, the lining of the Graafian follicles. The development of the ovary proceeds by the growth of the epithelial layer or "germ epithelium," and of the fibrous stroma, whereby eventually the epithelial cells become embedded in the stroma, with the exception of a single layer, which remains upon the surface, to form the epithelial covering of the ovary. As to the exact nature of the process, histologists are not yet agreed. Pflüger described the ingrowth from the surface of gland-like tubules, having a basement membrane, lined with a definite epithelium, and having larger round cells in their middle. These larger cells, according to his description, formed the ovules; the epithelial lining of the tubules became the epithelium lining the follicles. Constrictions were first formed by the ingrowth of the stroma, so that, at this stage, a series of "egg-chains" was produced. Eventually the septum became complete, and each ovum was inclosed in a separate capsule, constituting the Graafian follicle. Waldeyer, whose authority has been largely followed, described the embedding as taking place by a reciprocal growth, upward, of processes of the stroma, and downward, not of the tubules, but branching columns of epithelial cells, without any basement membrane, which columns were eventually cut up into clusters. At a very early stage some of the cells were conspicuous by their large size, and these were the "primordial ova." Each cluster, as a rule, eventually contained one only of the primordial ova, while the smaller cells remained still small, and, by numerous divisions, arranged themselves around the primordial ovum, to form the epithelium of the follicle.

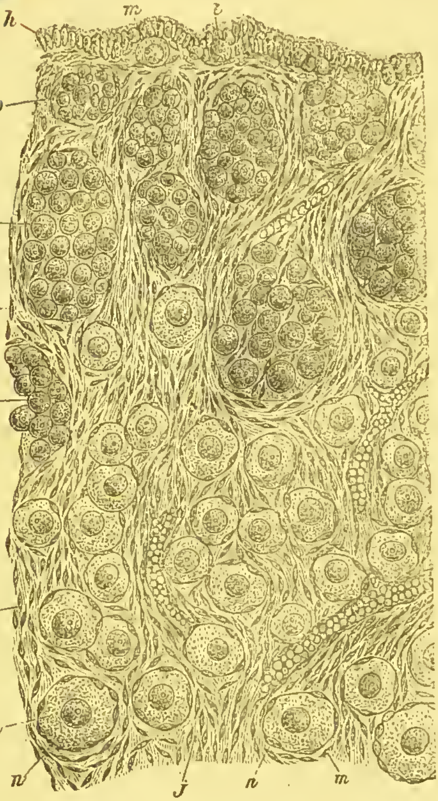

Fig. 19.—Section through the ovary of a human fœtus of seven months. On the surface is seen the germ epithelium (*h*); at *l* is seen a large spherical germ epithelium corpuscle; lower down groups of similar corpuscles, or egg-clusters (*o*), are embedded in the meshes of the connective tissue stroma (*j*); many primordial ova (*m*), in various stages of development, are seen, chiefly in the lower part of the figure; in contact with each primordial ovum are fusiform connective tissue corpuscles (*n*), similar to the fusiform corpuscles of which the stroma consists; numerous blood-vessels ramify throughout the ovary. (After Foulis.)

In the more recent researches of Foulis * a somewhat different account is given. Foulis describes every epithelial cell which becomes embedded as destined to form an ovule. According to him, the embedding takes place mainly by upgrowth of processes of the fibrous stroma penetrating amongst the germ epithelium as trabeculæ, thus enclosing clusters of cells in compartments, and finally enclosing every single epithelial cell in a separate compartment. The primordial ovules lie at first naked in the midst of the stroma, and the cells which form the epithelial lining of the follicles are derived from the connective tissue corpuscles, and not from the germ epithelium. There is no doubt that this view of the origination of the cells of the membrana granulosa from the connective tissue receives some confirmation from the appearance of follicles at a very early stage of development, even in the adult ovary, of some animals, including the human subject. The ovum is seen surrounded only by a few spindle-shaped cells resembling connective tissue cells rather than epithelium. It is also supported by the behaviour of the cells of the membrana granulosa in forming the corpus luteum, which is eventually converted into a fibrous cicatrix. It may well be that the ovule, itself an epithelial cell by origin, influences the cells around it while present in the follicle, causing them to proliferate into cells which behave like epithelium for the time, but, after the ovum has escaped, proceed to form connective tissue.

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* Trans. Royal Soc. Edin., Vol. XXVII.

From the mode of origin of the ovary, it follows that it is not covered by the peritoneum in the same sense as the other viscera. The superficial layer of the original germ epithelium is not developed into ovules, but becomes the epithelial covering of the ovary (*h*, Fig. 19, p. 30; *e*, Fig. 20, p. 32). It is continuous with the peritoneal epithelium, but it is prismatic, and not flattened. The outer fibrous covering of the ovary, the so-called *tunica albuginea*, is simply a superficial condensed portion of the fibrous stroma of the organ. It derives its name from its whitish colour, due to its vascularity being less than that of the interior of the organ. Like the rest of the stroma, it contains involuntary muscular fibres, as well as connective tissue.

All the ovules which are to be developed in the ovary exist in it at birth, and a far greater number are present than are required for ovulation throughout the whole period of active sexual life. The number at birth has been estimated as high as 35,000. A considerable proportion, however, appears to become atrophied, and disappear, so that in adult life, and even at puberty, the number is much smaller.

Structure of the Ovary.—The ovary is generally described as made up of two portions—a cortical zone, containing the Graafian follicles, and an internal portion, consisting of the fibro-vascular stroma. This distinction, however, exists only in infancy and early childhood, and ceases to be marked before puberty, although the follicles are always chiefly situated near the surface. The stroma is made up of wavy connective tissue, mingled with elastic fibres, and also a considerable quantity of involuntary muscular fibres. To the action of the latter considerable importance is attached by some authorities, as influencing the rupture of the follicles, and the expulsion of the ova. On section of an ovary after puberty, a few follicles are seen which have reached sizes varying from $\frac{1}{12}$ up to $\frac{1}{4}$ inch, but the great majority are visible only on microscopic examination.

From the section of a cat's ovary (Fig. 20, p. 32) it will be seen that the smallest follicles lie close to the surface. As they get somewhat larger, they lie deeper in the ovary, but, as they approach maturation, their superficial part again approaches the surface until the covering gives way (see Fig. 21, p. 32). The explanation is that, the superficial layer of the ovary being denser than the subjacent stroma (see Fig. 20), the enlarging follicle at first goes inward in the direction of least resistance. When it has got so large that it can go no further inward, it begins to stretch and thin the overlying layer of stroma, till at length it bursts. In the human ovary follicles of anything beyond the smallest size appear less numerous, in proportion to the stroma, than in that of the cat.

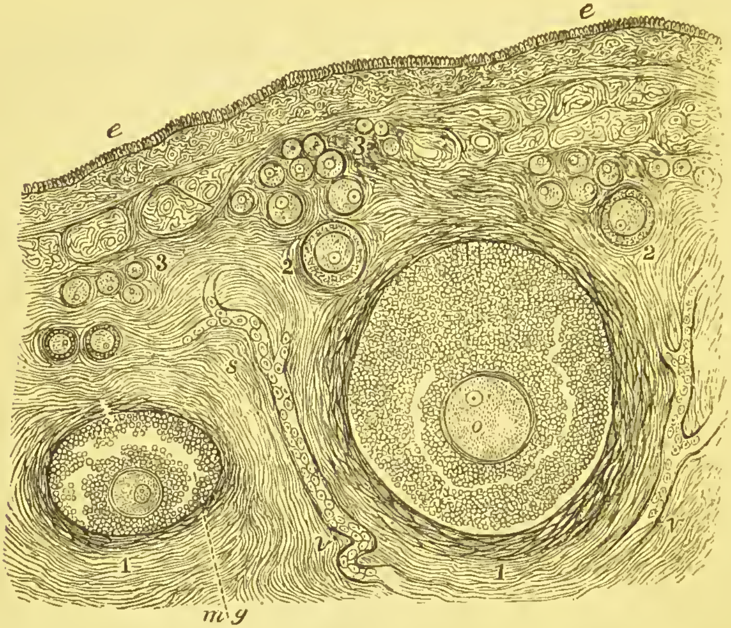

Fig. 20.—Section of a portion of cat's ovary. *e*, epithelium; *mg*, membrana granulosa; *v*, vessel; *o*, ovule; *s*, connective tissue stroma; 1, medium-sized follicles; 2, smaller follicles; 3, smallest follicles.

The Graafian follicle, when approaching maturity, is generally described as having three coverings. Of these, the innermost is alone of importance. The outermost layer, or tunica fibrosa, consisting of highly vascular connective tissue, and the middle layer, or tunica propria, are simply formed by the condensed stroma of the ovary and the vessels supplying the follicle. The innermost layer is an epithelial lining, called the membrana granulosa, and is made up of rounded granular cells, several layers deep (*m g*, Figs. 20, 22). At one spot on the circumference there is a thickening of the epithelium, forming a projection called the

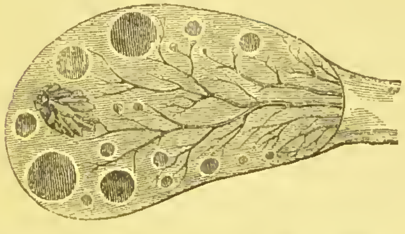

Fig. 21.—Section of human ovary, showing Graafian follicles approaching maturation. (About twice the natural size.)

discus proligerus, and in this the ovum is embedded. At an early stage of the development of the follicle, its cavity is entirely filled by the ovum and the epithelium. As, however, it approaches towards maturity there is a relatively large space, filled with clear fluid, called the liquor folliculi (Fig. 22), which is believed to be a secretion formed by the epithelial cells, or, in part, to result from their dissolution.

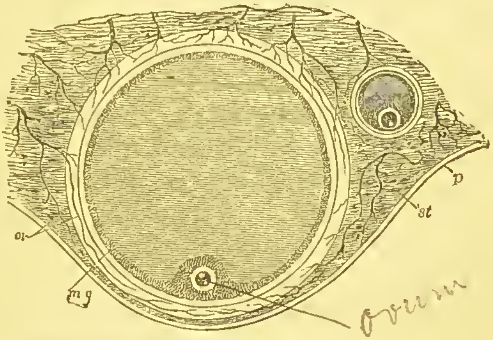

Fig. 22.—Section of two Graafian follicles of different sizes. *p*, peritoneal or quasi-peritoneal covering; *st*, ovarian stroma; *o v*, the two outer layers of the ovisac, the so-called tunica fibrosa and tunica propria; *m g*, membrana granulosa, or epithelial lining of the ovisac. Around the ovum the accumulated cells are seen forming the discus proligerus. (Enlarged about eight diameters.)

The *ovum* itself may be regarded as a greatly developed cell, having its nucleus and nucleolus. Its diameter is about $\frac{1}{200}$ inch. Its outer covering, corresponding to the cell-wall, is a tough, elastic, and transparent membrane, called the *zona pellucida* or *vitelline membrane*. In some of the lower animals there exist openings, to allow the access of the spermatozoa, either in the form of a single aperture, the *micropyle*, or of numerous minute pores. Nothing of the kind has been detected in the mammalian ovum.

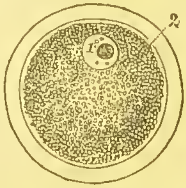

Fig. 23.—Human ovule. 1, germinal vesicle; 2, yolk.

The cavity enclosed by the zona pellucida is filled by the *yolk* (2, Fig. 23), a semi-fluid, somewhat granular, protoplasmic mass, which corresponds to the cell-substance. At the centre of the yolk in an early stage of development, and, at a later stage, on some point of the periphery, is the *germinal vesicle* (1, Fig. 23), corresponding to the nucleus of the cell. It is slightly oval, and more transparent than the yolk, but contains a few granules, and the *germinal spot*, or nucleolus. In mammalia the germinal vesicle is about one-sixtieth of a line in diameter.

Relation of Menstruation to Ovulation.

Menstruation consists of a discharge of blood from the mucous membrane of the body of the uterus, accompanied by an increased secretion from the mucous glands of the uterus and vulva. The discharge recurs at intervals which normally are generally from twenty-eight to thirty days. The intervals, however, vary somewhat in different women, and in some cases, without any departure from health, they are habitually as short as three weeks or as long as six weeks. The degree of regularity of the intervals also varies in different persons, but any great irregularity generally implies some deviation from perfect health. The intervals are to be reckoned not from the end of the period, but from the beginning of one to the beginning of the next.

The duration of the discharge and its amount also vary greatly, both in different women, and in the same woman at different times and under different circumstances. From three to four days is the commonest duration of the flow in this country, but it may last only a few hours, or as long as eight days, without disturbance of health. It generally commences gradually, becomes most profuse about the second or third day, and then gradually diminishes. The total amount of blood normally lost at the period is variously estimated at from two to six ounces, and about three ounces may probably be taken as the average. The quantity is greater in hot climates than in cold; and it is also increased by luxurious living, and by premature or undue mental stimulation.

Character of the Menstrual Fluid.—The menstrual blood has usually the peculiarity of not coagulating. This depends upon its becoming mixed with the acid vaginal mucus; for if the discharge be collected by a speculum as it issues from the cervix, it is alkaline, and coagulates like ordinary blood. If the amount of blood be excessive, or if it be poured out suddenly, clots are formed, the amount of vaginal secretion being then insufficient to prevent coagulation. If the amount of blood be not at any time excessive, and yet clots are formed, it may be inferred that the outflow of blood from the uterus does not take place freely, so that the blood has time to clot within the uterus before becoming mixed with the vaginal secretion. Before drawing this inference, however, it is necessary to make sure that the supposed clots are not really shreds of uterine mucous membrane.

On microscopic examination of the menstrual fluid, besides blood and mucous corpuscles, and vaginal epithelium, there is to be seen epithelium from the cavity of the uterus. Not unfrequently, also, shreds can be detected, showing the structure of the mucous membrane of the body of the uterus. Sometimes these form thin flat pieces, in which the openings of the uterine glands, and occasionally even the epithelial lining of those glands, may be seen.

The menstrual fluid has a peculiar odour, depending upon the mucous secretion mixed with it, and analogous in some measure to that which exists in animals during the period of rut. The fluid very readily decomposes, but apart from decomposition, there is no foundation for the popular prejudice that it has especially injurious properties. The relative proportion of blood to mucus in the menstrual fluid increases from its commencement up to its maximum, and gradually diminishes again towards its close.

Source of the Menstrual Blood.—It is now universally agreed that the source of the menstrual blood is the mucous membrane lining the body of the uterus, and this alone. It does sometimes happen that, under the influence of the active arterial flux caused by the menstrual nisus, hæmorrhage takes place from the cervix uteri, or even from the vagina or vulva, when there exists an erosion, ulcer, or recent wound in these regions. Again, in cases of retention of menstrual fluid from atresia of the vagina or cervix uteri, the Fallopian tubes have sometimes been found distended with blood as well as the uterus, but shut off by a constriction from the uterine cavity. In these instances the mucous membrane of the Fallopian tubes must have poured out blood during menstruation. All these cases, however, are only instances of an abnormal condition.

With regard to the exact mechanism of the escape of the blood from the mucous membrane, there is not yet so much agreement. Theories have been held that the blood transudes through the walls of unbroken capillaries under the influence of congestion, or that permanent openings exist from the vessels into the uterine glands, closed merely by muscular contraction through the inter-menstrual intervals; and these theories have not yet been entirely abandoned. But the evidence largely preponderates in favour of the view of which Pouchet and Tyler Smith were the first chief supporters, namely, that at each menstrual period more or less of the surface of the mucous membrane is broken up and cast off, allowing the blood to escape through the torn capillaries. There is no doubt that, in a special morbid condition, the so-called "membranous dysmenorrhœa," a considerable thickness of mucous membrane is separated and thrown off in one or several pieces. It is also a fact, although not so universally recognised, that a certain approximation towards this condition is quite common, especially in women who suffer pain in menstruation from the first outset of that function. In such cases a careful examination of the menstrual fluid frequently reveals shreds which microscopic examination shows to belong to the body of the uterus, and to contain either the apertures for the glands, or sometimes the entire structure of the glands, including the epithelial lining.

If the uterus of women who have died within about ten days after the cessation of the last menstrual period be examined, the mucous membrane is found to be generally not more than from $\frac{1}{20}$ inch to $\frac{1}{10}$ inch in thickness, and it shows no very sharp line of demarcation from the muscular wall beneath, the extremities of many of the glands dipping into the muscular layer. If death take place during a period of amenorrhœa, the condition is very similar. If, however, a woman who menstruates normally has died very shortly before the expected onset of a period, the thickness of the mucous membrane is generally much greater, being often as much as $\frac{1}{6}$ inch at its thickest part. The cells of the interglandular tissue appear to be less closely packed, but retain their small size, differing entirely, in this respect, from the cells of the decidual membrane of pregnancy. The more developed mucous membrane is usually sharply marked off, by a straight border, from the muscular wall of the uterus. This increased thickness of mucous membrane before menstruation can hardly be accounted for solely by swelling due to infiltration of serum, and apparently indicates that, at each menstrual period, a certain portion at least of the surface is thrown off, and renewed by growth during the intermenstrual intervals.

In cases of death during menstruation, more or less of the mucous membrane has been found disintegrated and removed ; but on this point the evidence is at present conflicting. The difficulty of settling the question arises from the fact that fatal diseases may gravely alter the normal menstrual changes, a uterine hæmorrhage which is not true menstruation often occurring shortly before death. The softened mucous membrane also easily undergoes *post-mortem* dissolution. Tyler Smith believed that the mucous membrane was completely exfoliated, and described and figured the uterus of a woman who died during menstruation, in which the mucous membrane ceased abruptly at the os internum, that of the body of the uterus being entirely wanting. Sir John Williams also holds that the whole of the tissues generally regarded as mucous membrane is disintegrated and cast off. He believes, however, that the inner portion of the muscular wall of the uterus corresponds, in development, to the muscularis mucosæ, although completely blended with the usual muscular wall of a hollow viscus ; and in the uterus of the sheep he finds evidence of a demarcation indicating that the inner third of the muscular coat has this character. In the human uterus, judging from the depth at which the vessels encircling the organ are placed, he infers that the major part of the muscle belongs to the muscularis mucosæ, and that the vessels form a demarcation between the two parts. This author describes four cases in which he found the mucous membrane entirely absent over part, or the whole, of the body of the uterus, after death during menstruation, but all these were cases of death from acute febrile diseases.

This view has not yet been supported by any other histologists. Leopold records, amongst others, two cases of sudden death by accident during menstruation, and concludes that only a very superficial layer of the mucous membrane is thrown off. Engelmann denies even so much exfoliation as this. Spiegelberg extirpated an inverted uterus during menstruation, and found the mucous membrane intact, except a partial loss of the most superficial epithelial layer. Wyder records two cases of death from accident on the fourth and eighth days respectively from the commencement of menstruation. He finds a notable loss of thickness of the mucous membrane during menstruation, but no disintegration of its whole thickness. Mr. Bland Sutton reports that Macaque monkeys and baboons are the only mammals which menstruate besides women. The sanguineous discharge from the uterus however is very slight and soon ceases, although the coincident coloration of the genital organs lasts from three to seven days. Mr. Bland Sutton finds no destruction even of the epithelium in either animal, either in the uterus or Fallopian tubes. He could obtain no light whatever as to the source or cause of the hæmorrhage. According to Heape, on the other hand, monkeys in India menstruate about every month, in a very similar way to women. In observations made especially upon Semnopithecus entellus, Heape finds exfoliation of the superficial part of the mucous membrane, by which the vessels are laid open. He suggests, as an explanation of Sutton's negative results, that normal menstruation may be interfered with by a life of confinement in England. In a case of sudden death of a woman by drowning ten days from the beginning and seven from the end of a period, I found a fully developed mucous membrane, $\frac{1}{6}$ inch thick—a thickness which seems to be too great to be consistent with the whole thickness of mucous membrane having been thrown off in menstruation. I have also snipped out a small portion of the surface of an inverted uterus at the end of menstruation, and found a thickness of mucous membrane as much as $\frac{1}{10}$ inch existing. The evidence, therefore, is on the whole in favour of the view that the menstrual bleeding is due to a disintegration of the surface of the mucous membrane reaching to a proportion of its thickness, probably varying in different women, but not to its whole depth. On this view, in those cases in which either small shreds, or more complete pieces, of membrane are found in the menstrual discharge, there is an undue fibrillation or toughness of the exfoliated portion, so that the disintegration is less complete than it should be. The cause of the normal disintegration is probably to be found, partly in fatty degeneration of the tissue, partly in extreme pressure in the small vessels of the mucous membrane. Such fatty degeneration, preceding any actual exfoliation, is described by Sir John Williams, but its existence is denied by Leopold and Wyder.* Complete disintegration of the whole thickness of mucous membrane cannot be accepted as proved to be a normal occurrence, unless it be shown to have occurred when a healthy woman has died suddenly from accident, for it is quite possible that during the process of dying from disease, especially disease of febrile character, a pathological disintegration may occur.

Theory of Menstruation.—When the ovaries are congenitally entirely absent, no menstruation occurs, and the same result follows if the ovaries are removed in early life. Examples of this are said to exist, or to have existed, in the hedjeras, or guards to the harem, in certain parts of Asia. A stimulus to the nervous system originating in the ovaries is therefore essential to the first establishment of menstruation. It is also essential, in most cases, for its continuance. By the removal of both ovaries, whether enlarged by tumour or not, an artificial menopause is brought on as a general rule. Not very unfrequently, it is true, either irregular uterine hæmorrhage or even perfectly regular menstruation, continues after the operation. In some instances, however, this may be due to some small fragment of ovarian stroma, or a supplementary ovary having been left behind. Thus, in one case of oophorectomy, under the care of Dr. Battey, not only menstruation but pregnancy occurred after the operation, though only a minute fragment of stroma was left, and the same result has happened in other similar cases.†

Menstruation is to be regarded as analogous in some measure to the rut, or œstrus of animals, although important differences exist between the two. In animals the discharge of ova, and capacity for impregnation, exist only at the time of rut, and the female will receive the male at that time only. The period is marked by congestion of the genitals, and increased secretion of mucus, which, in some of the higher animals, may be slightly tinged with blood, and is accompanied by a special odour which attracts the male. In some animals, as in the stag, spermatozoa are secreted by the males only at the corresponding period. In the human subject, on the contrary, coitus may take place, as a rule, at any other time except that of menstruation. There is, nevertheless, an increase of sexual feeling in connection with the menstrual period. This is generally most marked after the flow, but may exist also during the flow, or just before its onset. In most cases the first menstruation is believed to mark the first ripening of ova. In some instances, however, ovulation occurs in girls who have never menstruated, as is proved by the fact that pregnancy has sometimes occurred before there has been any appearance of the menstrual flow. It is the general rule that, in connection with each menstrual period, one or more ova are discharged, but exceptions to this rule are not uncommon. The occurrence of ovulation without menstruation is proved by pregnancy taking place during periods of amenorrhœa, and by occasional cases of oophorectomy performed about the middle of an intermenstrual interval, in which a follicle is found apparently just ruptured. That of menstruation without ovulation is shown by instances in which no sign of recent or impending rupture of a follicle has been found when death has taken place or oophorectomy has been performed, just after, or during, normal menstruation, as well as by those in which menstruation has persisted after double ovariotomy or oophorectomy.

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* For evidence as to the changes of the mucous membrane in menstruation, reference may be made to the following papers. Sir John Williams "On the Structure of the Mucous Membrane of the Uterus and its Periodical Changes," Obstet. Journ. Great Britain, Vols. II., V.; Leopold, "Die Uterusschleimhaut und die Menstruation," Archiv für Gynäkologie, Bd. XI., 1877, p. 111; Wyder, "Beiträge für normalen und pathologischen Histologie der menschlichen Uterusschleimhaut." *Ibid.*, Bd. XIII., 1878, p. 15; Bland Sutton, "Surgical Diseases of the Ovaries and Fallopian Tubes," p. 7; Heape, "The Menstruation of Semnopithecus entellus," Phil. Trans., London, 1894.

† R. Battey, "Oophorectomy." Transactions of International Medical Congress, 1881.

Cycle of Menstrual Changes.—The effects of menstruation are not confined to the uterus and ovaries, nor to the time of the menstrual period, but there is a monthly cycle of nutrition influencing in some degree the whole organism. In susceptible women there is often, for some days before the flow, a fulness with tenderness of the breasts, which begins to pass away as soon as the flow commences. This condition appears to indicate a tendency to commencing development in the breasts, coincident with the monthly development of the uterine mucous membrane. Sphygmographic observations have shown that the arterial tension is generally somewhat raised above the average before the flow, and sinks to a level rather below the average during, and shortly after the flow. According to Dr. Stephenson's observations, both the temperature of the body and the excretion of urea also follow a monthly cycle. The curve of temperature is above the mean for about half the month, rising to about half a degree above the mean line; it crosses and falls below that line about, or shortly before, the time of onset of menstruation, and sinks to a similar depth below it for about a similar interval. The curve indicating the excretion of urea follows a very similar course. There are thus general signs of increased activity of nutritive changes coincident with the time of development of the uterine mucous membrane.

The cause of the monthly periodicity cannot be explained, but it probably lies in the nervous centres rather than in the ovaries. This view appears to be confirmed by the effect which a nervous shock, such as a fright, or excessive muscular exertion, often has in bringing on menstruation prematurely. The commencing maturation of the Graafian follicle is probably the consequence rather than the cause of the same arterial afflux of blood to the uterus and ovaries which causes the development of the uterine mucous membrane. As the maturation proceeds, a reflex stimulus from the ovarian nerves increases the afflux of blood until menstruation is determined. In morbid conditions of the ovary, when maturation of follicles is interfered with, or hastened by undue congestion, menstruation is apt to be irregular, or its rhythm to be altered. That the afflux of blood precedes the onset of menstruation is illustrated by what is observed in the case of soft fibroid tumours. Such tumours often vary perceptibly in size during the menstrual cycle, and it is generally found that the greatest size is reached a little before the onset of the flow, and that a diminution takes place either during its course, or at, or even just before, its onset.

Active arterial hyperæmia continues, however, throughout the menstrual flow, and is one of the factors which determines the amount of blood lost. Thus the increased activity of circulation produced by coitus, or great muscular exertion, increases the amount of flow, and is apt to bring it on again, after it has recently ceased. Congestion extends to the vagina and vulva throughout the period, and if death occurs during menstruation, the whole vicinity of the uterus and ovaries is found greatly congested. The muscular wall of the uterus is, however, sometimes found pale and comparatively bloodless, and this condition is to be explained by the occurrence of muscular contractions. The occasional contractions which are manifest to the hand in the pregnant uterus take place also in the unimpregnated uterus during menstruation, and probably at other times. They serve to expel the product of menstruation, and close up the increased cavity left in the body of the uterus by the exfoliation of mucous membrane. It is possible also that uterine contraction may determine the first rupture of vessels at the onset of menstruation by forcing blood out of the muscular wall into the mucous membrane, and checking its return through the veins. A pale condition of the muscular wall after death during menstruation does not, however, prove that it is continuously bloodless during the flow, but only that the blood has been squeezed out of it by contraction before death, or by rigor mortis. With the expulsive contractions of the fundus is associated some physiological relaxation of the cervix; but any material dilatation of that canal probably only occurs when something bulky, such as membrane, clot, or mass of tenacious mucus, has to be expelled.

Maturation of the Graafian Follicle.—As the Graafian follicle enlarges it at first recedes from, but afterwards again approaches the surface of the ovary (see p. 31). Under the influence of the hyperæmia preceding menstruation there is great enlargement and proliferation of the vessels in the vascular tunic of the follicle which is nearest to maturity. From the increased vascular supply follows increased secretion of the liquor folliculi, and the follicle comes to form a prominence on the surface of the ovary. From the effect of pressure the wall becomes thinned at the most prominent part, and fatty degeneration takes place in it. At length rupture occurs and the ovum escapes with the rush of liquor folliculi, aided, as some hold, by the pressure of blood previously effused into the follicle. The actual rupture takes place at a point previously free from vessels, and is facilitated by the fact that the ovary has no distinct fibrous capsule, nor true peritoneal covering. At the same time there is, as is generally believed, a kind of erection from active congestion of the Fallopian tube and its fimbriated extremity, so that the latter is more closely applied than usual to the ovary. The motion of the cilia lining the fimbriæ produces a current of serum towards the orifice of the tube, and by this means the ovum is guided into it. Much importance has been attached to the grasping of the ovary by the fimbriæ of the tube during menstruation. The fimbriated extremity, however, is not large enough to grasp the whole ovary, and the capacity for erection of the Fallopian tube appears to have been exaggerated. The current produced by the cilia must, therefore, be of great consequence, and be capable of guiding an ovum toward the tube, even when it has escaped outside the grasp of the fimbriæ. The possibility of this is illustrated by the case of batrachians, in which the oviducts are situated at a distance from the ovary, and the ova are discharged, in the first instance, into the peritoneal cavity. In this way also may be explained the cases in which an ovum escaped from one ovary has been carried into the Fallopian tube of the opposite side, and there arrested.*

The disposition of the tube is also such that the action of gravity is favourable to the ovum reaching its orifice. The length of the tube being much greater than the distance from the uterus to the ovary, the tube curls over the ovary in a loop, so that its outer third comes to be outside and below the ovary, the ovarian fimbria which is attached to the ovary running downwards from that organ to the orifice of the tube. The fimbriæ, therefore, are in contact with the ovary at or near its most dependent part.* It is probable, however, that it is not very rare for an ovum to escape into the peritoneal cavity and not reach the tube.

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* See the chapter on extra-uterine fœtation.

Period of rupture of the Graafian Follicle.—When it was supposed that the swelling of the uterine mucous membrane took place during menstruation and not before its onset, it was believed that the time of rupture of the Graafian follicle was shortly after the end of a period. Modern observations point rather to the conclusion that it more frequently ruptures just before the commencement of a period. Some observers, however, believe that, as in woman sexual feeling is no longer limited to one epoch, but spread over the whole menstrual cycle, so ovulation takes place at irregular and uncertain dates in the same cycle. It cannot be denied that this is, at least, an occasional occurrence. From the apparent analogy between the supposed exfoliation of mucous membrane in menstruation and the exfoliation of the developed mucous membrane, the so-called decidua vera, at the end of pregnancy, the mucous membrane developed for menstruation has been called the menstrual decidua. It has further been supposed by some that the separation of this decidua, and consequent commencement of menstruation, indicates that the ovum belonging to that menstrual period has not only escaped, but has failed to become impregnated. It would follow that the impregnated ovum belongs, not to the last menstrual period which occurs, but to the first which fails to appear; and that the duration of pregnancy, generally reckoned from a few days after the end of the last period, is shorter than has generally been supposed. This is not supported by cases of pregnancy from a single coitus of known date. Moreover, there is reason to believe that the ovum may take as much as nine or ten days in passing from the ovary to the uterus. If, therefore, it be true that the exfoliation is only of the superficial portions of mucous membrane and not of its whole thickness, the new mucous membrane, denuded of its epithelium, and beginning to be renovated, may be in condition to furnish a suitable nidus for the ovum of the period just past, by the time it reaches the uterus, even though it escaped just before the period. Recorded cases, where a Graafian follicle has been found on the point of rupture, but unruptured, during or just after menstruation, seem to show that menstruation does not necessarily mean the failure of impregnation of the corresponding ovum. On the whole it may be inferred from the evidence that the follicle may rupture just before, during, or just after the period. Of these times the first is probably the commonest; and it is also reasonably believed that an impending rupture may be precipitated by the increased congestion, and perhaps the contraction of the muscular fibres in the ovaries, induced by coitus.

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* See a paper by His, "Die Lage der Eierstöcke in der weiblichen Leiche," Archiv für Anatomie und Physiologie, 1881.

Formation of the Corpus luteum.—Even before the rupture of the follicle, its internal layer or membrana granulosa becomes thickened by proliferation and enlargement of the cells composing it, and acquires a characteristic yellow tint, due to the presence of minute yellow granules in the cells. After the rupture this change becomes much more marked. By proliferation within a confined space the layer of cells becomes thrown into folds, which have been compared to cerebral convolutions (Fig. 24, p. 43). These gradually encroach upon the space occupied by the clot in the centre, which shrinks and becomes decolorised, and eventually leaves only a whitish stellate spot at the centre. The round cells increase in size, and their yellow colour becomes more marked. Between the cells young connective tissue is formed, and vessels penetrate the layer from the outer wall of the follicle, entering between the convolutions as papillæ of vascular connective tissue. The convolutions when pregnancy has occurred eventually blend together so as to form a uniform border round the central remnant of clot, as shown at *f*, Fig. 24. It was held by Coste that there is normally no

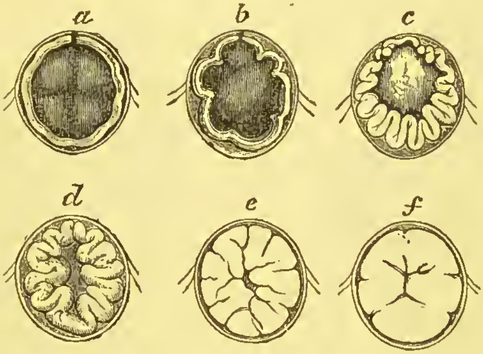

Fig. 24.—Diagram of the formation of the corpus luteum. *a*, the cavity of the follicle filled with blood; *b*, *c*, the clot diminishing in size, while the epithelial lining becomes thickened and convoluted, and the clot becomes decolorised; *d*, *e*, *f*, completion of the process. In *f* the convolutions have coalesced to form a yellow mass the decolorised remnant of the clot remaining only as a central stellate cicatrix.

effusion of blood into the follicle, but only a semi-transparent gelatinous material, slightly tinged with blood-pigment. Dalton,* however, found only one specimen of a corpus luteum of menstruation in which the central clot was absent as compared with nine in which it was present. The size of the corpus luteum thus formed is considerably greater than that of the original follicle (see Fig. 25, p. 44).

When the ovum has not become impregnated, the development of the corpus luteum has reached its height after about twenty days; after this it undergoes rapid absorption. The cells gradually disappear, the colour is changed from yellow to a whitish tint, the vessels become atrophied, and eventually there remains only the relic of the fibrous tissue which the cells have formed, and which has the appearance of a stellate white cicatrix. The diminution is already considerably advanced by the time the next follicle is ready to rupture, though the yellow colour is generally noticeable for two or three months. Such a corpus luteum has been termed a false corpus luteum, but is better named the corpus luteum of menstruation. The corpus luteum of menstruation, when at its greatest development, remains, as a rule, at the stage shown at *d*, Fig. 24. Some remnant of dark clot can be seen near the centre, or toward the surface of the ovum: the convolutions of the membrana granulosa are distinguishable, not blended into a uniform mass, and they

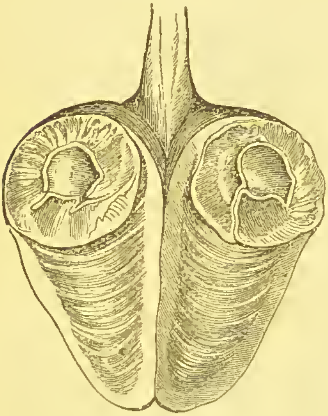

Fig. 25.—Section of the human ovary, showing a corpus luteum at the third month of gestation, containing a central cavity.

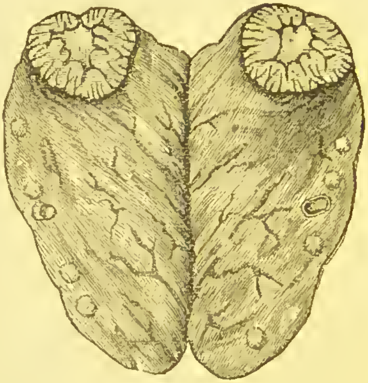

Fig. 26.—Corpus luteum at the full term of pregnancy. (After Dalton.)

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* "Report on the Corpus Luteum." Transactions of the American Gynecological Society, Vol. II.

are most developed in the part of the follicle farthest from the surface.

If pregnancy occurs, a very different course is followed. The maturation and rupture of fresh follicles is then, as a rule, arrested. In consequence of the hyperæmia due to pregnancy the corpus luteum reaches a much higher development, and this development is more protracted, as also is the diminution. The greatest height is reached about the third month; the corpus luteum is still marked at the time of delivery, and does not entirely disappear for one or two months after. At the third month it is about two-thirds of an inch in length (Fig. 25), and forms a manifest prominence on the surface of the ovary; at the time of delivery it still averages nearly half an inch in length (Fig. 26). The yellow colour is more marked; at the early stage the convolutions are firmer to the touch; eventually they blend together in a firm mass, their margins being only indicated by bands of connective tissue. The cells reach about $\frac{1}{600}$ or even $\frac{1}{500}$ inch diameter. The corpus luteum can be felt as a manifest firm swelling in the substance of the ovary. This is not generally the case with the corpus luteum of menstruation. In about one-third of the cases a cavity is formed in the substance of the corpus luteum, containing clear fluid (Fig. 25), but more frequently the centre is occupied by the stellate decolorised relic of the blood-clot, like that shown in Fig. 26. The formation of a cavity is ascribed by Dalton to a separation and collection of the serum belonging to the original blood-clot. It is rarely, if ever, observed in the corpus luteum of menstruation.

The corpus luteum of pregnancy formerly had the less appropriate name of the true corpus luteum. The only structure which really deserves the name of false corpus luteum is that which may be formed if a follicle shrinks, and its wall becomes thickened without rupture ever having taken place. This is distinguished from a corpus luteum of pregnancy or menstruation by the absence of the yellow colour, and by the fact that it is not on the surface of the ovary, nor connected with a cicatrix on that surface.

The corpus luteum has no positive medico-legal value as a proof of pregnancy. For a few cases have been recorded in which the corpus luteum of menstruation has appeared to have all the characters usual in that of pregnancy. This has generally been in instances where there has been some cause for undue congestion, such as the presence of a fibroid tumour or a life of prostitution. On the other hand there have been cases of pregnancy in which no corpus luteum or none of distinctive character could be found.

Commencement and duration of Menstruation.—The first menstruation is the usual sign that the girl has become capable of conception and child-bearing. It is believed to be coincident, as a rule, with the first ovulation, although, in some cases, ova are discharged previous to any menstruation. At the same time occur the changes, physical and mental, which indicate the arrival at the age of puberty. The body of the uterus, hitherto small in relation to the cervix, is developed, the pubes becomes covered with hair, the pelvis acquires the typical female type, and the breasts are developed. At the same time there is a mental change, and the girl becomes more bashful and retiring. Neither the body of the uterus, however, nor the pelvis, at once reach their full capacity for the discharge of their functions; they do not generally attain their full size till the age of about twenty. The age at which menstruation commences is influenced by climate, race, and mode of life. The influence of climate has been exaggerated, but in hot climates the age is on an average two or three years earlier than in cold.

Luxurious living and early stimulation of the mental faculties tend to bring on menstruation at an earlier age, and thus the children of the rich and dwellers in towns commonly menstruate earlier than the poorer classes in the country. Premature sexual stimulus has a similar effect. Feeble health and poor diet tend to retard the appearance of the flow. There may be a difference between different races living in the same country, and among the Hindoos, whose custom is for marriage to be completed as soon as menstruation appears, the age is peculiarly early.

The age of appearance of menstruation may vary from 10 to 20 without departure from health. In England more than half of the whole number of girls first menstruate between the ages of 14 and 17, and more than five-sixths between those of 13 and 19, the average age being a little above 15½. Normally the discharge recurs at regular intervals, with the exception of periods of pregnancy and lactation, up to the menopause or climacteric period, which is commonly between the ages of 40 and 50, most frequently at about 48. Exceptionally menstruation may go on even up to the age of 60. The period of active sexual life is thus generally from 30 to 35 or 40 years. Those who menstruate early commonly continue to menstruate late, unless any pelvic inflammation has led to atrophy of the ovaries. Repeated pregnancies tend to prolong the period of sexual activity. Cases occasionally occur in which true menstruation begins in infants, even at the age of two or three, and continues regularly from that time. Such a condition is associated with premature development of the breasts, of the pelvis, and of the sexual emotions. In such a case pregnancy has occurred in the ninth year, and the birth of a living child in the tenth.

Conception.—Conception is effected by union of the spermatozoa with the ovum. One or more spermatozoa penetrate the zona pellucida, and, on reaching the yolk, become motionless, and lead to certain changes in the nucleus hereafter to be described. The micropyle, or opening through the zona pellucida for the entrance of spermatozoa, though it exists in lower animals, as insects and fishes, has not been detected in mammals. It is believed that the ovum is generally fertilised in the Fallopian tube, probably for the most part in its outer half, and more especially among its fimbriæ, the folds of which form a receptacle in which the semen may be retained for some time. This belief is based mainly upon experiments on the lower animals, in which the spermatozoa may be found along the whole length of the tube, and on the surface of the ovary, a few hours after coitus. Nuck placed a ligature on one horn of the uterus of a bitch three days after coitus. Some time later two embryos were found in the tube arrested by the ligature. Again, if a bitch be subjected to coitus just after the rut is over, and killed a few hours later, ova and spermatozoa are found along the whole length of the tube, but, in its lower two-thirds, the spermatozoa have not penetrated the vitelline membrane. This is explained by the change which takes place in the ovum as it passes along the tube, owing to the addition to it of an albuminous envelope. The phenomena of extra-uterine fœtation show that, in women also, the spermatozoa may reach the peritoneal cavity. The precise mechanism by which the ascent of the spermatozoa is effected, is not positively known. A great deal must be attributed to their own power of motion, since, according to Henle, they can traverse the distance of an inch in 7½ minutes. Many cases of pregnancy with narrow and unruptured hymen have been recorded, and spermatozoa have traversed minute openings in a vaginal septum. I have known a case of pregnancy where the vagina was contracted up to a rigid tube, only $\frac{1}{6}$ inch in diameter, so that penetration was totally impossible, while urine was constantly trickling through this tube from the bladder. In such instances, the spermatozoa must have made their way by their own activity the whole length of the vagina, as well as of the uterus and Fallopian tube. Besides the movements of the spermatozoa themselves, the effect of capillary attraction, and of suction exerted in some way into the uterus, have been thought to have an influence on the ascent of the spermatozoa, and both of these may be important elements in the matter in some cases. Modern physiologists also attach importance to *chemiotaxis*, by which is meant the attraction or repulsion exercised upon organisms by fluids of different kinds. In the majority of instances, it is sufficient for impregnation that semen is deposited in the vagina; but there is reason to believe that, in women of ardent temperament at any rate, some portion of it often ascends almost immediately into the cervix. This is the only explanation of the fact that injections of cold water, or various solutions, used immediately after coitus as a prophylactic against pregnancy, not unfrequently fail to secure the desired result, though they are immediately fatal to the spermatozoa wherever they reach the semen.

Normally there is in coitus as distinct an orgasm of sensation on the part of the woman as that which accompanies emission in the man. It is not necessarily associated with ejection of the secretion of any gland, but is accompanied by certain muscular actions. The sexual orgasm is not necessary to conception, for the condition in which it is habitually absent, or what may be called impotence in women, is by no means uncommon, and pregnancy frequently occurs notwithstanding. The occurrence of the orgasm at the proper time does however favour conception. I have known a lady who was married under 20, and lived in married life for many years with two husbands in succession. When she had passed the age of 40, she experienced the sexual orgasm in coitus for the first and only time in her life, and from that day dated her first and only pregnancy.

It is difficult to imagine any mechanism by which the uterus can exercise active suction, although a suction toward the abdominal cavity may sometimes be caused by sudden expansion of the chest during the sexual orgasm, with closure of the glottis. But the most probable explanation is that in such cases mucus is displaced from the cervical canal by pressure due to impact of the penis, and that, in the intervals of pressure, semen ascends to take its place out of the pool of that fluid just deposited in the posterior vaginal fornix.

Period of Possible Impregnation.—Since the spermatozoa may remain alive in a suitable medium for ten days or more, and the ovum may occupy probably ten days in descending to the uterus, it is obvious that a fruitful coitus may take place almost at any part, and probably at any part, of the menstrual cycle. It has long been believed that the greatest aptitude for conception exists shortly after the end of a menstrual period. Nature seems to give some evidence in favour of this view, since the period of most acute sexual feeling is generally just after the end of menstruation, although this may extend also to the time just preceding the flow. A similar conclusion may be drawn from a comparison of the duration of pregnancy in cases of single coitus on a known date with its duration as reckoned from the end of the last menstrual period. The former period is, on an average, 272 days,* the latter 278 days.† It may be inferred from this that the fruitful coitus probably takes place, on an average, about six days from the end, or ten days from the beginning, of the last menstrual period. Recorded cases seem to show that this is, at any rate, a possible time for fruitful insemination, as for instance two instances mentioned by Marion Sims, in which pregnancy followed a single known coitus at such a date, and one in which it was the result of intra-uterine injection by him of seminal fluid. Raciborski concluded, arguing however from only fifteen cases of a single coitus, that, in rather more than half, the fertile coitus occurred in the two days following menstruation.

On the other hand, if the doctrine mentioned above were true, that the commencement of menstruation is a sign that impregnation of the ovum discharged in connection with that period has failed, it would follow that coitus is least likely to be fruitful just after the end of a period, and most likely to be so a few days before the onset of a period. It is a strong argument against this doctrine that it would seem a strange anomaly of nature for sexual feeling to be strongest exactly at the time when impregnation is least likely. Some evidence on this question may be derived from the case of the Jews. In the Jewish law, Jewish women are directed to abstain from coitus during menstruation, and for seven days after its cessation.‡ Strict observers of the law are said to go beyond what is commanded in Leviticus, and even if the discharge lasts only for an hour or two, to observe five days during which the discharge *might* last, for the period itself, and add to these seven clear days, making twelve in all, at the least. Less strict observers of the law, however, keep only three days after the cessation of the flow, or merely occupy separate rooms while it actually continues. It is much to be doubted whether, whatever may be laid down in the Priestly Code, a whole nation was ever induced to practise abstinence at the period of most acute sexual feeling. It is probable that, with Jewesses who observe strictly the Levitical law, the fertile coitus is generally shortly before the period, but there are no statistics as to the duration of pregnancy from a single known coitus in those who observe the Jewish law. The only final conclusion which can be drawn at present is, that coitus shortly before or shortly after a period is more likely to be fruitful than at other times. It is said that some women conceive only when coitus takes place actually during the menstrual flow; but it is comparatively rarely that this is put to the test.

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* Löwenhardt's statistics give 272 days (Die Berechnung und die Dauer der Schwangerschaft. Archiv für Gynäkologie, III., 1872); Ahlfeld's, 271 (Beobachtungen über die Dauer der Schwangerschaft. Monatsschrift für Geburtshülfe, XXXIV., 1869); Stadfeldt's, 272 (Annales de Gynécologie, VIII., 1877, p. 227); Matthews Duncan's, 275 ("Fecundity, Fertility, and Sterility," Edinburgh, 1871).

† According to Matthews Duncan. Löwenhardt (op. cit.) reckons 282 days from the *first* day of menstruation, an estimate which closely corresponds with that of Duncan.

‡ See Leviticus, xv. 19.

CHAPTER III.

EARLY DEVELOPMENT OF THE OVUM.

The details of the development of the ovum belong to embryology, and only so much will be considered here as is necessary in order to understand the formation of the envelopes of the fœtus which are of practical importance in midwifery. These are, from without inwards, the decidua, the chorion, and the amnion, of which the first belongs to the uterus, the two latter to the ovum. The earlier of the changes now to be described are only inferred to take place from the analogy of what occurs in the lower animals, and some of the earliest have not been observed even in mammals.

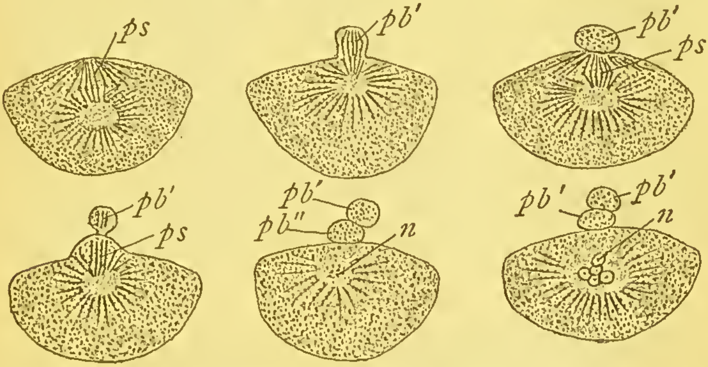

Fig. 27.—Formation of polar bodies in Asterias glacialis. *ps*, polar spinale; *pb′*, first polar body; *pb″*, second polar body; *n*, nucleus. (After Hertwig.)

Maturation of the Ovum.—Maturation occurs independently of impregnation, and consists of certain changes in the germinal vesicle or nucleus. The nucleus approaches the surface of the yolk and becomes attached to it by a band, the polar spinale (Fig. 27). At this spot a portion of the nucleus is gradually extruded from the yolk, forming the first polar body. A repetition of the same process leads to the formation of the second polar body. The nucleus, reduced in size, recedes again from the surface, and is now termed the female pronucleus (Fig. 27).

Segmentation of the Yolk.—This occurs only after impregnation. A spermatozoon having penetrated the zona pellucida, its tail disappears, and the head, blending with a portion of the yolk, forms the male pronucleus. The male and female pronucleus gradually approach and blend together, forming a larger nucleus, resembling the original germinal vesicle, and called the segmentation nucleus. This immediately divides into two; the two new cells are again subdivided into two, and so on, until a large number are produced, all lying within the vitelline membrane. The body so produced has been called the *muriform* body, from its mulberry-like appearance. The cells are seen to be of two sorts, the smaller and more numerous arranging themselves on the surface, the larger and less numerous forming at first a heap, and then a subjacent layer of cells. In the centre of the ovum a clear fluid is formed, thus the ovum is converted into a vesicle, whose walls are composed of two layers of cells, more or less hexagonal from mutual pressure, within the zona pellucida. This cellular layer is called the *blastodermic membrane*; the superficial layer of cells the *epiblast* or *ectoderm*; the deeper layer the *hypoblast* or *entoderm*. Later, a third layer, the *mesoblast* or *mesoderm*, is formed between them.

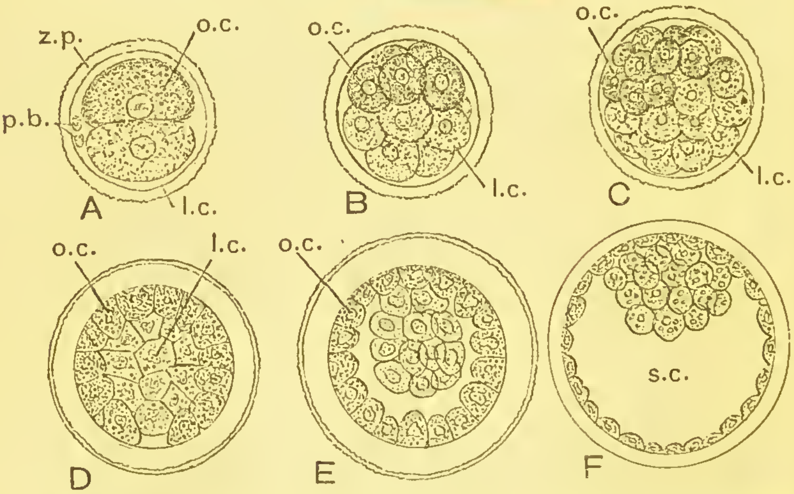

Fig. 28.—Segmentation of mammalian ovum. z.p., zona pellucida; p.b., polar bodies; o.c., outer cells; i.c., inner cells; s.c., segmentation cavity.

The Primitive Chorion.—While these changes are going on, the ovum is passing down the Fallopian tube. In its passage it is supposed to receive an additional very thin albuminous coating, the analogue of the important layer which forms the white of the egg in birds. This albuminous coating becomes closely blended with the zona pellucida, and over the whole surface of the resulting membrane simple structureless villi are formed. In this way is produced the *primitive chorion.* The villi serve both for absorption of nutritive material, and for attachment of the ovum to the mucous membrane as soon as it reaches the uterus. By such absorption, the ovum, which was about $\frac{1}{120}$ inch in diameter on escaping from the ovary, has increased to from $\frac{1}{50}$ to $\frac{1}{25}$ inch in diameter by the time it reaches the uterus.

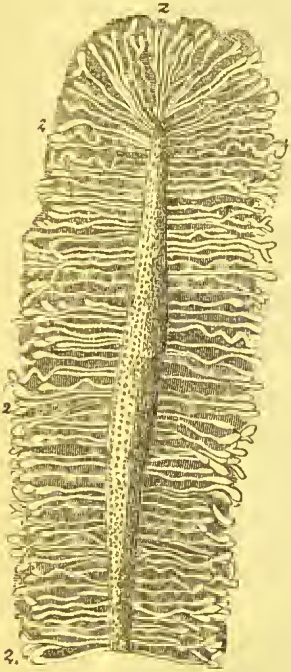

Fig. 29.—Section of the mucous membrane of the body of the uterus at the very commencement of pregnancy, twice the natural size. 1, opening of the glands on the surface of the cavity; 2, the utricular glands.

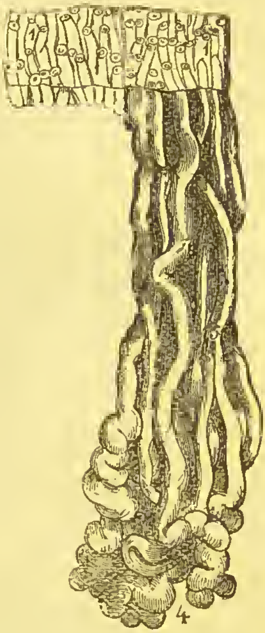

Fig. 30.—A portion of the glandular structure, magnified about ten times. 1, 1, orifices of the glands; 4, cæcal extremities of glands; 5, tubular portions of glands.

Before describing the further changes in the ovum after it has reached the uterus, it is well to consider the changes in the uterus itself, which result in the formation of the *decidua* or outermost of the three envelopes of the ovum.

The Decidua.—The effect of impregnation on the uterus is, that a development of the mucous membrane of its body immediately commences. The cells of the interglandular tissue proliferate and grow to a large size, round or somewhat spindle-shaped, reaching a diameter of about $\frac{1}{500}$ inch. At the same time the glands become enlarged and their cavities somewhat dilated. The ovum on reaching the uterus finds its cavity nearly filled up by the

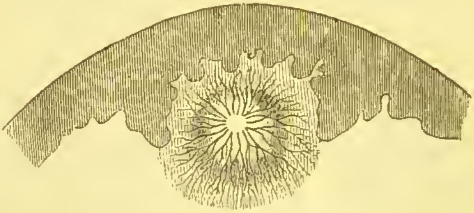

Fig. 31.—First stage of the formation of decidua reflexa.

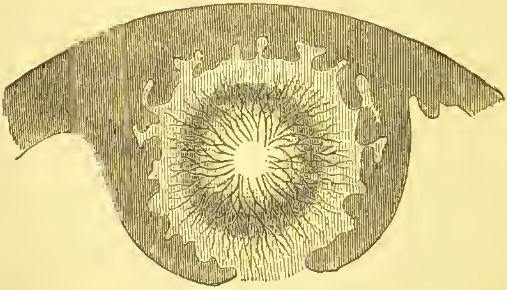

Fig. 32.—More advanced stage of formation of decidua reflexa.

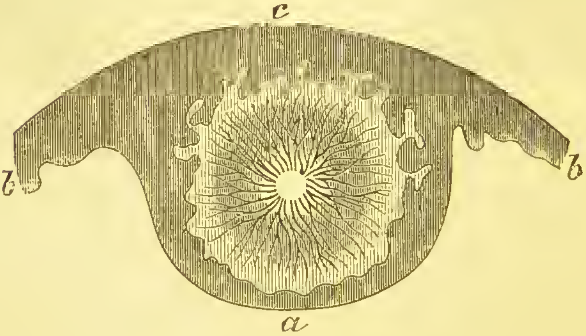

Fig. 33.—Completion of decidua reflexa.

mucous membrane, and becomes, as a rule, attached at a point not far from the orifice of the Fallopian tube, most frequently on the posterior wall. The proliferating mucous membrane grows up around the ovum until it completely covers it in and shuts it off from the cavity of the uterus (Figs. 31—33). Owing to the minute size of the ovum when it reaches the uterus, it is easily covered in this manner. That portion of the developing mucous membrane to which the ovum is attached is called the *decidua serotina*, and forms eventually the site of the placenta, the rest of the mucous membrane lining the uterus is called the *decidua vera*, and the portion which covers the ovum from the uterine cavity is called the *decidua reflexa.* The proof that the decidua reflexa is really derived from the uterine mucous membrane lies in the fact that it is composed of cells similar to those of the rest of the decidua, and that in a very early ovum glands may be detected in it, opening on its internal surface. On the external surface, gland openings are only found in that portion which is near to the uterine wall, and do not extend to the central portion, separating the ovum from the uterine cavity. The intermediate stage of a ridge of mucous membrane growing up around the ovum has not been observed in woman, but in one animal, the seal, such a condition is permanent, the growth stopping short at a ridge, and not going on to form an actual decidua reflexa. A slighter approximation to the formation of a decidua reflexa is seen in the zonary placenta of carnivora generally, a narrow strip of mucous membrane containing utricular glands being reflected on the margin of the zonular band of the chorion.

The inappropriate names given to the several portions of the decidua originated from a false theory of its origin. The decidua was correctly figured by William Hunter as being the developed mucous membrane. John Hunter, however, believed that it was a layer of coagulable lymph poured out from the surface of the uterus, and this view was long accepted by anatomists. It was supposed that this layer covered the surface of the uterus, including the orifices of the Fallopian tubes, before the ovum had emerged from the tube. The ovum, on arriving at the orifice of the tube, pushed a portion of the layer of lymph before it into the uterus, and this portion was called the decidua reflexa. The portion of the layer which remained undisturbed was the decidua vera. Finally, it was supposed that a fresh layer of lymph was poured out between the uterine wall and the ovum, and this, as being formed later, was called the decidua serotina (from *serus*, late).

Thus, in the early stage of pregnancy, there is a decidual cavity, which is in fact the cavity of the enlarging uterus, the ovum forming a prominence projecting into it. This cavity has three openings, the os uteri, and the orifices of the two Fallopian tubes. The Fallopian tube, however, from which the ovum descended, is liable soon to be occluded by its growth. The existence of the decidual cavity explains the fact that a sound may be passed into the uterus within the first three months of pregnancy without rupturing the ovum, and sometimes without interruption to the pregnancy, and also the fact that, in some exceptional cases, menstruation may continue during the first three months of pregnancy.

The thickness of the decidua is much greater at the early stage of pregnancy than in the later months, both absolutely and still more in proportion to the bulk of the ovum. The greatest thickness, which may be as much as $\frac{1}{3}$ inch for the decidua vera, is attained by the third month. By that time the decidua reflexa has already been thinned by stretching. The decidua vera and decidua reflexa then come into contact, and are blended together, the decidual cavity is obliterated, and the ovum occupies the whole of the body of the uterus. From this time the decidua becomes gradually stretched out and thinned, and after the sixth month the decidua reflexa cannot generally be detected as a distinct membrane.

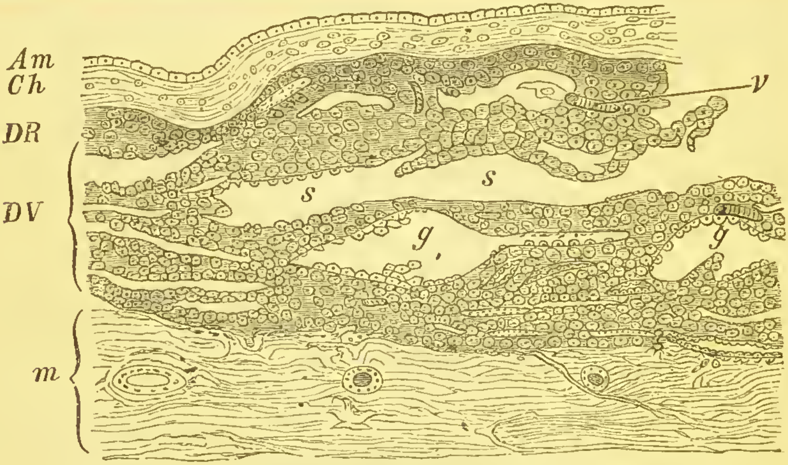

Fig. 34.—Section of membranes at the eighth month of gestation. *Am*, amnion; *Ch.* chorion; *DR*, decidua reflexa; *DV*, decidua vera; *s*, line of separation; *g*, glandular spaces; *m*, muscular wall of uterus; *v*, vessel. (After Leopold.)

The decidua vera, in its growth, gradually becomes divided into two layers. The inner layer, nearest the free surface, is made up mainly of the characteristic decidual cells, with but little intercellular substance. The cells have relatively large nuclei, and are somewhat granular. There are numerous thin-walled vessels, and the layer is pierced by the enlarged gland-tubes. Leucocytes are seen amongst the large cells, and numerous lymph spaces are believed to exist, especially around the vessels and the gland-tubes. In the outer layer, nearest the uterine wall, the dilated and flattened gland cavities form a more important element in the tissue. The cells are smaller, not so round, but more frequently spindle-shaped, and there is more intercellular substance. Between the two layers there is a thin stratum marked by large flattened spaces, which are generally regarded as being dilated gland cavities which have lost their lining epithelium. This has been called the ampullary layer, and is believed to form generally the surface of separation when the decidua is thrown off. The epithelium is generally wanting on the surface both of the decidua vera and reflexa. In an early abortion the openings of the glands may be seen with the naked eye, or more clearly with a lens, on the smooth internal surface of the decidua vera, and the same appearance may be seen when the uterus is opened before the third month of pregnancy. No such openings are seen on the decidua reflexa, except at a very early stage, close to its border. Before the full term of pregnancy fatty degeneration of the decidua takes place preparatory to its separation. By the fourth month the decidua reflexa has lost its vascularity, and the decidua vera has also lost it to a great extent when full term has arrived.

The decidua, as its name implies, is cast off at the end of pregnancy, and there has been a controversy whether the mucous membrane is thrown off completely, so that the muscular wall of the uterus is laid bare. The truth appears to be that more or less of the glandular layer of the developed mucous membrane remains attached, and forms the starting point for the growth of the new mucous membrane, whose surface epithelium is derived from the epithelium of the gland-tubes, like that of the freshly growing menstrual decidua. It is, however, so soft, that it may readily undergo post-mortem disintegration after delivery at full term. A certain portion of the decidua vera comes away attached to the chorion, the remainder is discharged in pieces with the lochia. A thin layer of the decidua serotina, pierced by the openings of the placental vessels, comes away on the uterine surface of the placenta.

Further changes in the Ovum.—The next change, after the formation of the blastodermic membrane (see p. 52), is that a spot, round at first, then oval, appears on the surface, formed by a thickening of the cell layers. This is called the area germinativa, and is destined to play the main part in the development of the embryo. At this spot an intermediate layer of cells is eventually formed, called the *mesoblast* or *mesoderm*, which also spreads over the whole surface of the ovum (see Fig. 36, p. 59). The part which these three layers of the blastodermic membrane play in the formation of the different organs of the body will not be entered upon here. The area germinativa soon shows a relatively bright and translucent oval space in the centre, called the *area pellucida* (Fig. 35, p. 58). In the centre of this appears a delicate dark line, the *primitive trace.*

It consists of a slight groove, bordered by two ridges, the dorsal plates, formed by thickening of the epiblast. Beneath this groove subsequently appears the *chorda dorsalis*, a cylindrical body, around which the vertebræ are eventually formed. The dorsal plates grow upward, curve towards each other, and meet in the middle line so as to form a closed tube (*mc*, Fig. 36, B), in which is developed the brain and spinal cord.

The Umbilical Vesicle.—While the dorsal plates are growing upward, or towards the surface of the ovum, the edges of the area germinativa curve inwards towards the centre of the ovum, both from the sides and from the ends. In this way is formed a kind of gutter, which is the first distinct indication of the formation of the embryo. This gutter is open towards the centre of the ovum, or what eventually becomes its ventral surface, and convex on its dorsal surface (Figs. 36, 37). The incurving edges of the area germinativa divide the blastodermic vesicle into two parts, that which is enclosed within the embryo becoming the interior of the intestinal canal, while that which is left outside is called the *yolk sac or umbilical vesicle* (*y*, Figs. 36, 37). The portion between becomes constricted into the form of a pedicle, the *vitelline duct*, and upon the duct and the vesicle are distributed an artery and vein, the *omphalo-mesenteric* vessels. The umbilical vesicle is at first large in comparison to the cavity within the embryo, and for a time the embryo derives the greater part of its nutriment from it (A, C, D, Fig. 37, p. 60). As the embryo grows, and the vesicle shrinks up, the latter soon becomes relatively small in the ovum of a mammal, and as soon as the allantois, shortly to be described, has reached the chorion it is no longer of service (F, Fig. 37). In abortions up to about the second month, the umbilical vesicle is readily seen (Fig. 50, p. 80). It may even be detected at full term near the border of the placenta, on the fœtal surface of the placenta outside the amnion, or in the funis, and the relics of the omphalo-mesenteric vessels, running

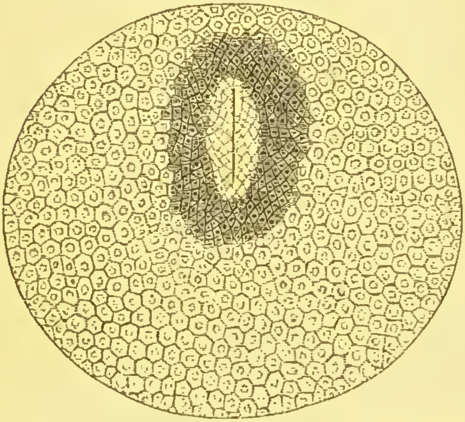

Fig. 35.—Diagram of area germinativa. In the centre is the primitive trace; immediately surrounding it is the area pellucida, bounded by the dark area vasculosa.

to it from the insertion of the funis, may sometimes be traced beneath the amnion. The pedicle of the umbilical vesicle may however, as the vesicle becomes separated to a distance from the embryo, be ruptured and disappear.

The Amnion.—When the constriction which separates the umbilical vesicle from the intestine has yet reached only an early stage, the embryo is already thickened towards the cephalic and tapering towards its caudal extremity, and its back is arched somewhat above the level of the rest of the ovum. At this time commences a cleavage of the blastodermic membrane into two layers round the whole border of the area germinativa. The cleavage passes through the mesoblast, so that the outer layer is composed of the epiblast with part of the mesoblast, the inner layer of the rest of the mesoblast with the hypoblast. The outer layer is called the somatopleure (*smp* in Fig. 36, and A, B, Fig. 37), and that part of it which belongs to the region of the embryo forms the body-walls. The inner layer is called the splanchnopleure (*spp* in Fig. 36, and A, B, Fig. 37), and that part of it which belongs to the region of the embryo forms the wall of the alimentary canal (*i*, Figs. 36, 37). The cleavage is not confined to the border of the region of the embryo, but eventually extends completely round to the opposite pole of the yolk-sac, and the yolk-sac thus becomes a free vesicle within the ovum (see B, E, F, Fig. 37). The space between the two layers is shaded with lines in Figure 37, and is called the pleuro-

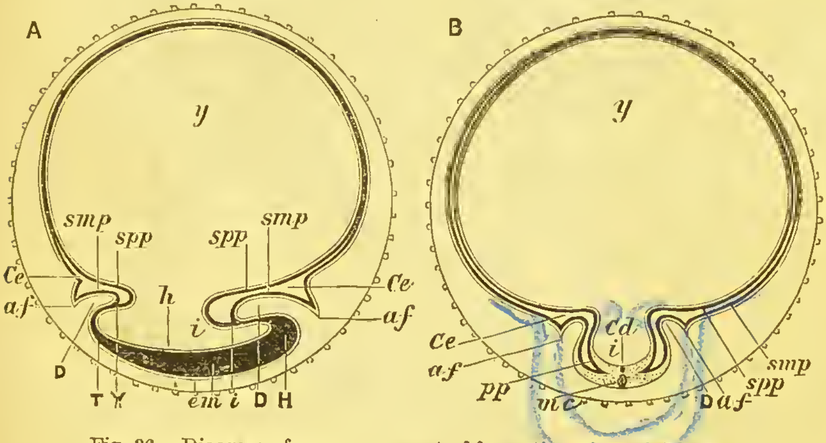

Fig. 36.—Diagram of commencement of formation of amnial folds.

A, Longitudinal section; B, Transverse section. *af*, amnial fold; *i*, interior of alimentary canal; *y*, yolk-sac or umbilical vesicle; *e*, epiblast; *m*, mesoblast; *h*, hypoblast; *Ce*, cœloma externum; *pp*, pleuro-peritoneal space or cœloma internum; *smp*, somatopleure; *spp*, splanchnopleure; H, cephalic extremity of embryo; T, caudal extremity; D, depression between amnial fold and embryo; *Cd*, chorda dorsalis; *mc*, medullary canal.

peritoneal space (*pp*). That part of it within the limits of the embryo (*pp* in Fig. 36, and A, B, Fig. 37) becomes the pleuro-peritoneal cavity of the fœtus, or the cœloma internum. At first it communicates freely with the part of the space outside the constriction, or cœloma externum, as shown in the figures.

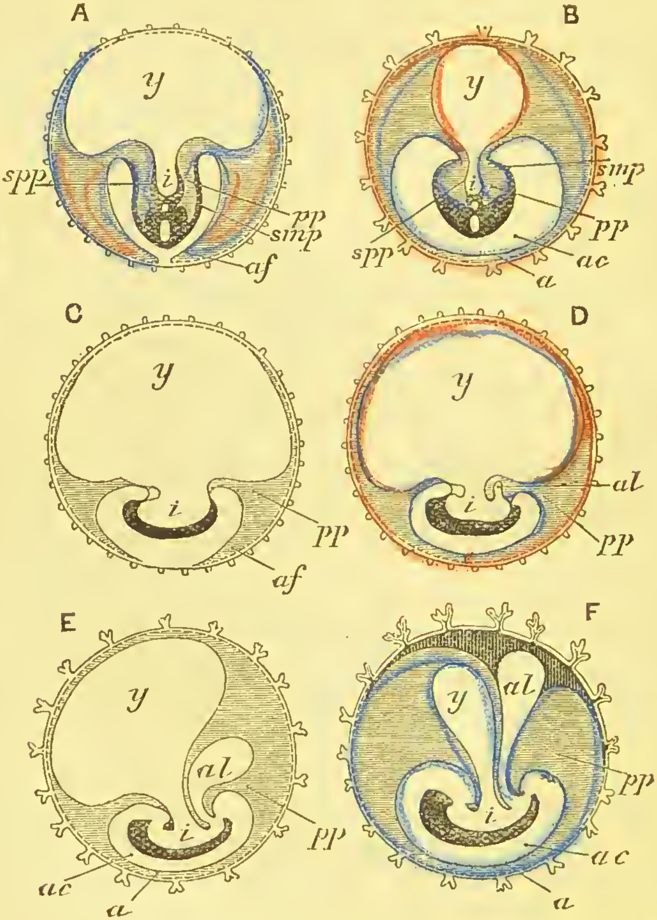

Fig. 37.—Diagrams to illustrate the development of the amnion and allantois.
A B. Transverse sections of the embryo. C, D, E, F. Longitudinal sections.
a f, amnial fold; *i*, interior of alimentary canal; *y*, yolk-sac or umbilical vesicle; *pp*, pleuro-peritoneal space, comprising cœloma internum and cœloma externum; *smp*, somatopleure; *spp*, splanchnopleure; *a*, amnion; *ac*, amnial cavity; *al*, allantois. The embryo is shown with its back downwards, the position in which it is usually placed.

The formation of the amnion is closely connected with the cleavage of the blastodermic membrane. It commences when the cleavage, which begins near the line of constriction between the embryo and the yolk-sac, has proceeded for a short distance. A little distance in front of the head the somatopleure becomes elevated into a fold, the amnial fold (*a f*, in Fig. 36, and in A, C, Fig. 37). This extends all round beyond the sides of the embryo and behind the tail. The embryo thus becomes surrounded with a hollow wall, which grows up towards its dorsal surface, and arches over its back, converging until it meets in the centre and covers it in entirely (D, Fig. 37). The fold thus consists of an outer and inner leaf. When it meets over the centre of the back, the double septum between its different parts (D, Fig. 37) is absorbed, and the outer leaf (sometimes called the false amnion) blends with, and is lost upon, the inner surface of the zona pellucida. The inner leaf becomes the true amnion (*a* in E, and F, Fig. 37), and encloses the amnial cavity (*a c*). The fluid afterwards poured out into the amnial cavity is called the liquor amnii, or amniotic fluid. At the same time that the amnial fold is converging to a centre over the back, the attachment of the inner leaf of the fold, eventually the true amnion, to the skin of the embryo, approximates towards a centre by the increasing constriction around the vitelline duct (compare B with A, and E with C, Fig. 37), and eventually surrounds the funis at the umbilicus.

The amnion is at first separate from the inner surface of the chorion, a semi-liquid gelatinous substance occupying the intervening space (*pp*). By the middle of pregnancy the amnion comes into close contact with the chorion, only a little gelatinous material remaining between them. It thus forms an investment surrounding the funis, and, with it, the pedicle of the shrunken umbilical vesicle. The amnion is always easily separable from the chorion. Exceptionally, fluid is still found between the two, even at the full term of pregnancy. In such case, after one bag of water (the chorion) has been ruptured in labour, a second (the amnion) may be found still intact. Some authorities describe vessels, derived from the allantois, as existing in the gelatinous substance between amnion and chorion, and as having a function in the secretion of the liquor amnii. Others describe *vasa propria* as existing in the amnion in the neighbourhood of the placenta at the early stage of pregnancy, and consider abnormal persistence of these vessels to be one cause of hydrops amnii.

Structure of the Amnion.—The ultimate disposition of the amnion is similar to what would result if an outer layer of epidermis were separated over the whole embryo by fluid effused beneath; but it differs in this respect, that, owing to its mode of formation, as above described, its epithelium looks inwards, and it contains structures derived from the mesoblast. The amnion is at all times non-vascular. It has a single layer of pavement epithelium, corresponding to the epidermis, and looking inward toward the amniotic cavity. Outside this there is a fibrous basement substance derived from the mesoblast, in which are seen spindle and stellate cells.

The Liquor Amnii.—The amnion is at first close to the back of the embryo, but it gradually becomes distended by a fluid, the liquor amnii, until it is brought into contact with the chorion. Relatively to the fœtus the amount of the liquor amnii is much greater in the earlier months of pregnancy, at which time the fœtus floats quite freely in it. Its actual maximum is reached about the seventh or eighth month, after which it is in part absorbed. The average quantity on delivery is from one to two pints. The amount of fluid varies greatly in different cases. The liquor amnii also varies greatly in specific gravity, 1004—1025, the average being from 1020 in the earlier months to 1010 at the end of pregnancy. It contains salts, chiefly chlorides and phosphates, some albumen, more in the earlier months than in the later, and urea towards the end of pregnancy. At first it is quite limpid and clear, but becomes somewhat more turbid towards the end of pregnancy from the fœtal lanugo and epithelial scales which are shed into it. It does not normally contain any of the alvine excretion of the fœtus, but occasionally, without any fœtal disease, it is found dark and discoloured.

Origin of the Liquor Amnii.—The liquor amnii is, in considerable part, derived from the maternal vessels and not from the fœtus. This is evident from cases in which the embryo has perished at a very early stage, but in which, nevertheless, liquor amnii is found to be present in proportion to the size of the ovum and not to that of the embryo, which in some instances may have entirely disappeared. The process must be one of transudation, chiefly from the maternal vessels of the placenta; but it is probable that the determination of the transudation in the direction of the amnial cavity may be due to a secreting power in the cells lining the amnion. It is probable, however, that the fœtal vessels are the more important source of the liquor amnii, for it exists in oviparous animals. The amnion itself has no vessels, but a system of capillaries is described starting from the umbilical cord and ramifying on the inner surface of the placenta, just under the amnion. These become atrophied towards the end of pregnancy, as also do the vessels already described (p. 61) as existing in the gelatinous material between amnion and chorion. Some notable proportion also of the liquor amnii, especially in the later months of pregnancy, is formed by the urine of the fœtus, which is discharged into it. This is proved not only by the presence of urea in the liquor amnii, increasing in amount towards the end of pregnancy, but by the fact that, when there is occlusion of the urinary passages of the fœtus, the bladder, ureters, or pelves of the kidneys become distended with urine.* In such instances the swelling of the fœtal abdomen so produced sometimes proves a serious obstacle to delivery, and necessitates embryotomy. By the increased amount of urine secreted by the fœtus towards the end of pregnancy, and the wasting of the capillary system on the surface of the placenta, is explained the change of composition in the liquor amnii in the later months. The proportion of albumen may diminish from about ·8 per cent. to ·08 per cent., while that of urea, which in the early months amounts only to a trace, may rise to ·35 or ·4 per cent.

Uses of the Liquor Amnii.—The liquor amnii provides a fluid medium in which the fœtus is suspended, and which protects it both from shocks or pressure from without, and from interference with its circulation by uterine contractions. It also gives space for those muscular movements of the fœtus which are doubtless of service in exercising its muscles and promoting its growth. In labour it is of great service by forming, with the protruding bag of membranes, a fluid wedge which dilates the cervix and os uteri. The liquor amnii is not supposed to furnish nutriment to the fœtus, but the fœtus occasionally swallows some of it, as is proved by lanugo and epidermic scales being found in the intestines.

The Allantois.—Before the folds of the amnion have completely met, the formation of the allantois commences by a depression on the inner side of the hypoblast, destined to form the lining of the future intestine. This depression carries before it the inner of the two layers into which the mesoblast has become divided, so as to form a projection into the space between the two layers, or cœloma internum (*al* in D, Fig. 37, p. 60). The allantois thus forms at first a hollow vesicle, its cavity opening into the lower end of intestine, or cloaca. The vesicle thus formed, according to the usual description, receives two arteries and two veins, and grows out rapidly between the umbilical vesicle and the amnion, that is to say, within the pleuro-peritoneal space, passing through first the cœloma internum and then the cœloma externum (*pp.* Fig. 37), until it reaches the inner surface of the chorion (Fig. 37, E, F). It quickly spreads over this, and thus performs the important function of conveying to it a vascular supply and connective tissue substratum. The expanding allantois with its tubular pedicle has been compared to an umbrella with its handle. According to some authorities the allantois covers the whole internal surface of the chorion; according to others, there is an area, corresponding to the back of the embryo, which the allantois does not reach, and where the amnion comes again into apposition with the outer layer of the amnial fold, now blended with the chorion. In birds, the allantois has a considerable development and a prolonged use, as it completely envelopes the yolk-sac. In the human race it is of small size, and rapidly disappears as a distinct structure, after carrying the vessels to the chorion, probably in a few days. The remnant of its pedicle, with its vessels—two umbilical arteries and two umbilical veins, of which one vein—the right—soon disappears, remain as constituents of the umbilical cord. Of the portion of the allantois which remains within the abdomen, the upper part persists as the urachus or suspensory ligament of the bladder—the lower part becomes the bladder. Except in this lower portion, the tubular cavity of the pedicle of the allantois disappears.

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* Joulin, however (Traité d'Accouchements, p. 308), denies this inference, having collected a number of cases in which there was occlusion of urethra without distension of bladder, and considering that the amount of urea in the liquor amnii is too small to justify the conclusion that the urine is habitually discharged into it.

A different view, however, has been maintained by His, who declares that umbilical vessels have been found reaching the chorion by a mesoblastic stalk at a period when the allantois itself is only beginning to appear. According to His, the cleavage of the mesoblast does not proceed to such an extent as to separate the embryo entirely from its envelopes; but a bridge of mesoblastic tissue remains near the posterior extremity, uniting the two layers of the mesoblast. Along this bridge, which he terms the *ventral stalk*, the umbilical vessels grow to reach the chorion. At a later period the allantois grows out towards the chorion, in contact with the ventral stalk, but never quite reaches the wall of the ovum. It participates with the ventral stalk and the umbilical vessels in the formation of the umbilical cord. According to this view it is not clear what is the function of the allantois.

CHAPTER IV.

THE CHORION, PLACENTA, AND UMBILICAL CORD.

The Chorion.—The formation of the primitive chorion with its structureless villi has been already mentioned (p. 52). These villi soon atrophy, and as soon as the epiblast comes into contact with the inner surface of the zona pellucida, the true chorion is formed by the union of the two. This also throws out villi, which at first are solid cellular processes, covered with epithelium. The chorion is, however, only completely constituted after the allantois has reached it, bringing the vascular supply (F, Fig. 37, p. 60). An artery and vein then enter each villus, and they carry with them a sheath of connective tissue, also derived from the allantois. The fibro-vascular element of the chorion has been termed the *endo-chorion*, the external layer of the membrane being the exo-chorion. The villi now grow with great rapidity, giving off branches, which in turn give off secondary branches, and so on, each branch being occupied by a vascular loop. A highly complex structure, like finely divided seaweed, is thus produced. The vessels soon occupy nearly the whole sub-

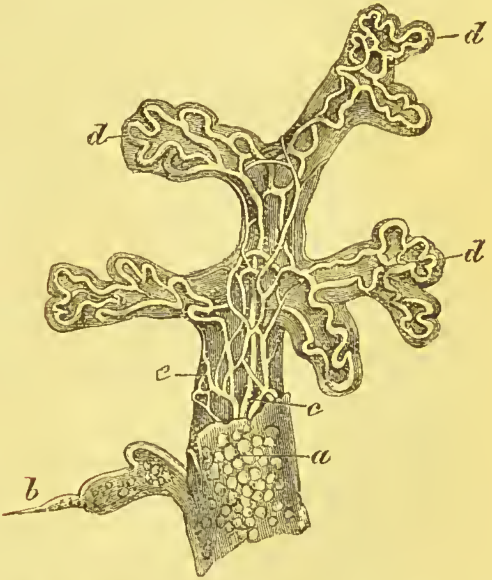

Fig. 38.—Chorionic villus magnified. *a*, epithelial covering; *b*, band uniting it to another villus; *c*, main arterial trunk of villus; *d*, terminal vascular loops; *e*, plexus of vessels between artery and vein. (After Ecker.) × 350.

stance of the ultimate branches of the villi, being covered only by a very thin connective tissue sheath, and an outer covering of epithelium.

According to the most modern view, in a well preserved specimen of a young placenta, a double layer of cells may be demonstrated covering the villi and all other parts of the chorion. After the mid-term of gestation, the deep layer disappears more or less completely. In a full-term placenta, even the superficial layer has disappeared from many of the villi, and the fœtal capillaries are only separated from the maternal blood space by a delicate layer of connective tissue.

The superficial layer consists of a thin stratum of granular multinucleated protoplasm, in which no cell outlines can be distinguished. This layer has been called by some the "syncytium." In the deep layer, the cells are large and well defined, with oval nuclei standing with their long axes at right angles to the surface.

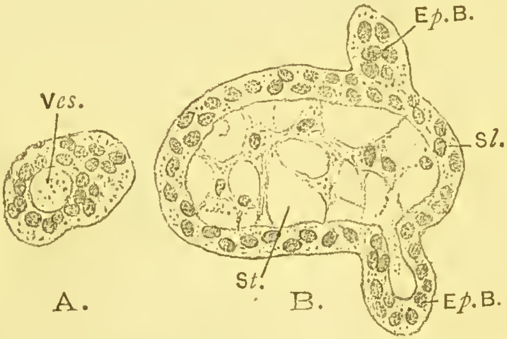

Fig. 39.—A, B, Sections of villi from an ovum at the sixth week.

ves, vessel; *Ep. B*, epithelial bud; *st*, stroma of villus; *sl*, superficial layer of epithelium. The deep layer is not seen. (After Eden.)

During the early months the superficial layer of epithelium shows great activity (Fig. 39). Proliferation occurs in localised areas, resulting in the formation of epithelial buds, which are the commencement of new villi. The chorionic stroma only enters the bud later (Fig. 39, B), and the deep layer of cells takes no part in the formation of buds. The part taken by the superficial layer in the formation of new villi appears to prove it to be of fœtal and not of maternal origin, although various authorities have held the contrary view. If this layer is of epiblastic and the deep layer of mesoblastic origin, the latter must be regarded as not truly epithelium, but merely connective tissue cells, arranged near the surface.

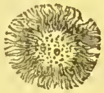

Fig. 40. — Very early human ovum, of date not exceeding fourteen days. (After Velpeau.)

In the larger branches, connecting vessels run between the artery and vein, in the smallest terminal twigs there may be only a single vascular loop (Fig. 38). The early terminal villi attach themselves on all sides to the decidua vera and reflexa. The attachment seems to take place by the epithelium being lost on the maternal side, the cells of the villus coming into close continuity with the decidual cells. In the early weeks of pregnancy the villi grow equally over the whole surface of the ovum, and furnish it with the shaggy covering which is seen in early abortions (Fig. 40). As pregnancy advances, those villi which are attached to the decidua serotina grow with increased exuberance, and eventually form the placenta, the organ of respiration and nutrition for the fœtus. Those attached to the decidua reflexa become atrophied, lose their vascularity, and eventually remain only as fibrous shreds, which may be seen on the outer surface of the chorion, even after delivery at term. The position of the placenta begins to be marked by the second month, and it has its characteristic formation by the end of the third.

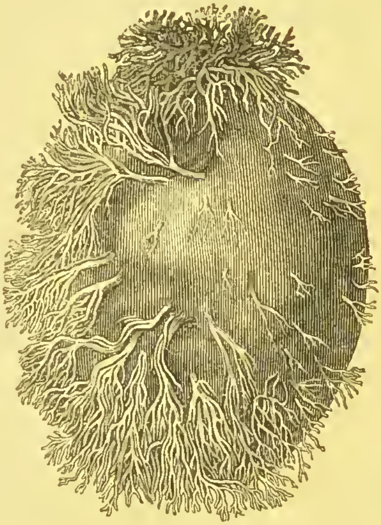

Fig. 41.—Human ovum of eighth week: the growth of villi preponderates at one part; at other parts the villi are already becoming atrophied. (After Carpenter.)

The Placenta.—A placenta consists essentially of two vascular membranes, one maternal and one fœtal, so closely interlocked together that, without any actual communication between the two vascular systems, interchange of gases and of nutritive and excretory material can take place between them.

Varieties of Placenta in Animals.—In the simpler forms of placenta found in animals, such as the diffused placenta of the mare, or the polycotyledonary placenta of ruminants, depressions or crypts more or less complex are formed by the developing maternal mucous membrane, into which are inserted tufts of chorionic villi. These crypts are not the enlarged mouths of the uterine glands, as was formerly supposed by some; but, on the contrary, the gland-tubes more frequently open on the ridges between the crypts, or on part of the mucosa not in contact with villi. The mode of their formation appears to be, that when one of the earliest villi has attached itself to the uterine mucous membrane, the membrane grows up into a ridge around it.* As the villus develops into a tuft, the crypt which is thus formed becomes more and more complex. The crypts have an epithelial lining, and the villi likewise have an epithelial covering. Between the two a small quantity of albuminous fluid can be detected, secreted by the epithelium of the mucous membrane, which thus discharges a kind of glandular function. To this fluid the name of "uterine milk" has been applied, and it is to its absorption by the villi that the fœtus owes its nourishment. When delivery takes place, the villi are drawn out of the crypts, like fingers out of a glove, and bring away with them either no maternal tissue, or only some of the epithelium. No bleeding therefore takes place, as a rule, in parturition. Such forms of placentæ are called non-deciduate.

In deciduate placentæ, such as the zonary placentæ of carnivora, the interlocking of the two membranes is more complex, so that they cannot be separated in parturition. The ridges of maternal mucous membrane not only grow up perpendicular to the surface, but send off partitions or trabeculæ at various angles, and the villi are divided into more complicated branching tufts. More or less of the maternal laminæ is then torn away in parturition, or on artificial separation of the placenta, remaining in the fissures between the fœtal portions of the placenta, and the maternal vessels are thereby ruptured. In some cases a more or less continuous layer of mucous membrane, forming a decidua serotina corresponding to that in the human subject, is also brought away in parturition on the uterine surface of the placenta. In this form of placenta, as in the simpler kind, a maternal epithelium covers the laminæ or trabeculæ of maternal mucous membrane, called decidual processes, and intervenes between the maternal vessels and the villi. Professor Turner describes an early stage of enlargement of maternal vessels into sinus-like spaces as visible in some parts of the placenta of the cat. In that of the fox, he finds the capillaries dilated to from twice to four times the capacity of the fœtal capillaries, and in that of the sloth he describes a still more remarkable dilatation of vessels, no maternal capillaries at all existing, and all the maternal vessels being of colossal size, as compared with capillaries.

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* See "Lectures on the Comparative Anatomy of the Placenta," by Professor Turner. Edinburgh. 1876.

Formation of Human Placenta.—The structure and mode of development of the human placenta have been the subject of a good deal of controversy. It is much more difficult to investigate than that of animals, because a trustworthy specimen to illustrate the earlier stages of development can only be obtained in the rare cases in which a healthy woman is killed suddenly within the first three months of pregnancy. According to the generally received account, the maternal blood is brought into much more immediate contact with the villi in the human placenta, and also in that of monkeys, than in that of any other animals. A great blood-containing space, with inter-communications throughout the whole placenta, is formed, into which large arteries open directly, while large veins carry the blood away from it into the uterine walls, the circulation through the blood-space itself being comparatively sluggish (see Figs. 42, 46). The mode of formation of the maternal blood-space is not fully determined. According to Turner and other anatomists, the maternal vessels of the decidual processes become gradually more and more dilated into great blood-spaces, until at length the septa between them are broken down, and the space becomes continuous throughout the whole placenta. The villi break through,

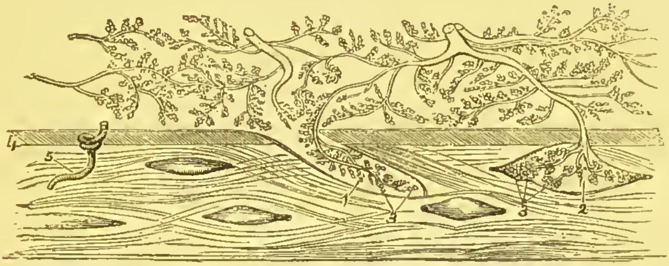

Fig. 42.—Diagram showing the relation of the villi to the maternal blood-vessels and the uterine wall, and the manner in which they occasionally penetrate the uterine sinuses. The villi are ramifying in the great maternal blood-space of the placenta. 1, uterine wall; 2, cavity of a sinus; 3, 3, tufts of villi dipping into sinuses; 4, decidua serotina; 5, curling artery of the uterus.

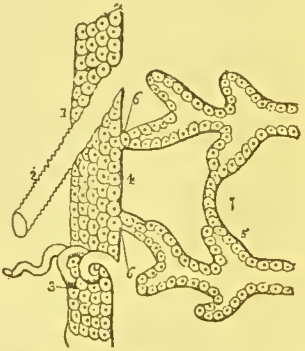

Fig. 43.—Diagram showing the mode of attachment of the terminal villi to the uterus. 1, decidua serotina; 2, a venous sinus passing obliquely through it; 3, a curling artery passing through it; 4, lining membrane of maternal blood-space of the placenta; 5, chorionic villus; 6, connection of villus with decidua serotina; 7, connection of one villus with another.

and ramify in this space, or, according to some, carry before them a layer of epithelium, which covers each villus. Professor Turner regards the partial dilatation of maternal vessels observed in the fox and the sloth as a stage on the way to the formation of a continuous blood-sinus such as that in the human placenta.

According to Webster, the first union of the ovum with the decidua takes place through the fœtal epiblast, or syncytium, which forms the outer covering of the chorion, before the chorion has acquired its vessels, or its inner mesoblastic layer. The outer epiblastic layer gets to consist of a thick nucleated protoplasmic mass, or plasmodium, which attaches itself to the decidua, taking the place of the maternal epithelium. As growth goes on vacuolation takes place in this mass, so that the ovum becomes connected to the decidua by a reticulated nucleated protoplasmic structure. The layer in contact with the decidua, which has been called the trophoblast, remains, and throws out branching processes which penetrate the decidua. These seem to correspond to the sections marked E. B. in fig. 44. The trabeculæ serve as pathfinders for the fœtal mesoblast, which penetrates them and forms a core, thus constituting permanent villus stems. Webster believes that,

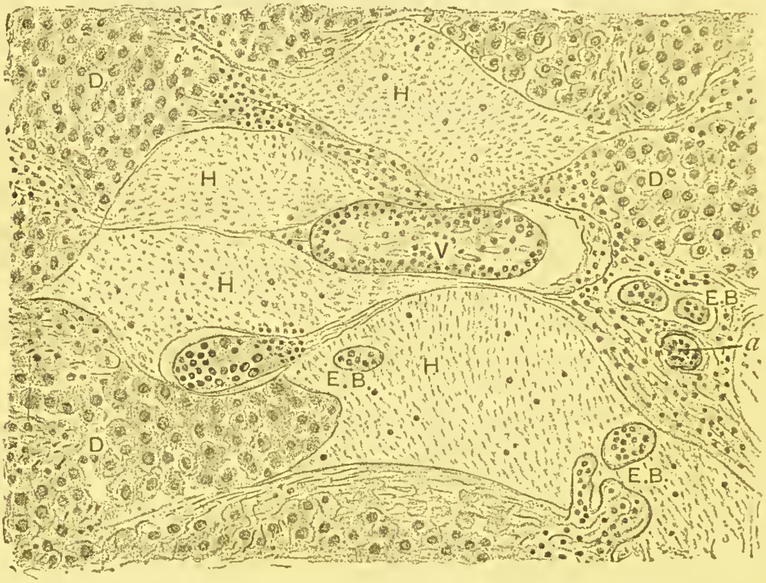

Fig. 44.—Vertical section through the decidua serotina at the sixth week, showing the penetration of the villi into the decidua. D, decidua; V, section of villus embedded in a hæmorrhage; H, hæmorrhages; E B, epithelial buds, from other embedded villi, not shown in the section; *a*, bud showing section of vessel in its interior. (After Eden.)

owing to the phagocytic action of the trophoblast, the decidual tissue is absorbed, and the maternal blood is thereby allowed to escape into the lacunæ formed in the trophoblast, which thus becomes the origin of the maternal blood-sinus of the placenta.

The most recent observations * describe the maternal blood-sinus as commencing by extravasations of blood outside the maternal vessels, and in the substance of the decidua serotina, which occur at an early stage of pregnancy. At first these extravasations coagulate, and become absorbed by the decidual cells. The chorionic villi penetrate the decidua serotina, and ramify in the extravasations (Fig. 44). Later on larger arteries open into the spaces of extravasation, and then the blood no longer coagulates, but a sluggish circulation is established through these spaces, which are extra-vascular, the blood returning by the veins. Finally the spaces are expanded, until they become continuous throughout the placenta. The maternal blood-space is made up of great lacunæ, nearer the fœtal surface, and smaller lacunæ, nearer the maternal surface, of

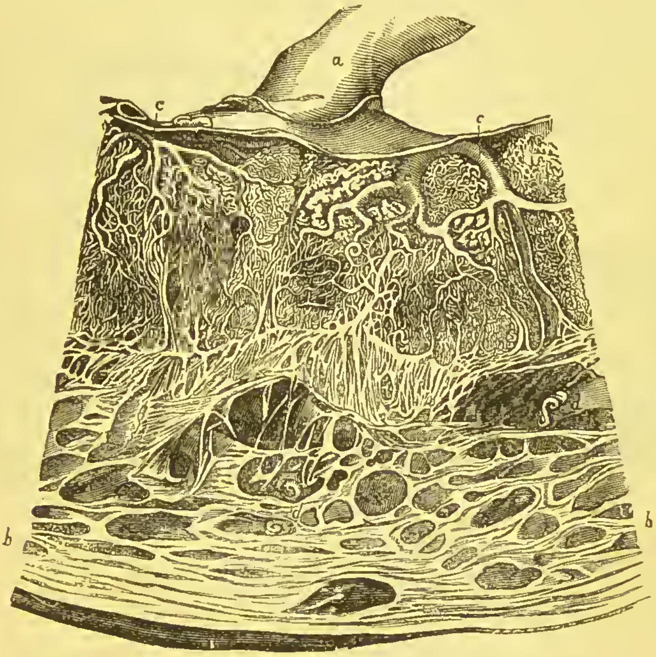

Fig. 45.—Section of fully-formed placenta, with part of the uterus. *a*, umbilical cord; *b*, *b*, section of uterus; *c*, *c*, *c*, branches of the umbilical vessels; *d*, *d*, curling arteries of the uterus.

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* Eden, "A Study of the Human Placenta. Physiological and Pathological." Journal of Pathology and Bacteriology, Jan. 189[illegible]

the placenta, all communicating with each other. In this way great freedom of interchange of material is allowed. Within the blood-spaces great proliferation of the villi goes on, so that at length they form a spongy mass, constituting the great part of the bulk of the placenta.[*]

Characters of the full-grown Placenta.—The placenta at full term forms a round or slightly oval mass, of spongy consistency. Its greatest diameter is, on the average, from 7 to 8 inches, its greatest thickness about an inch, and its weight about 20 ounces. It is generally inserted on the posterior or anterior wall of the uterus near the fundus, more frequently on the posterior. More rarely it is inserted on one side, and, if so, more frequently on the right, seldom absolutely on the fundus. Still more rarely it is

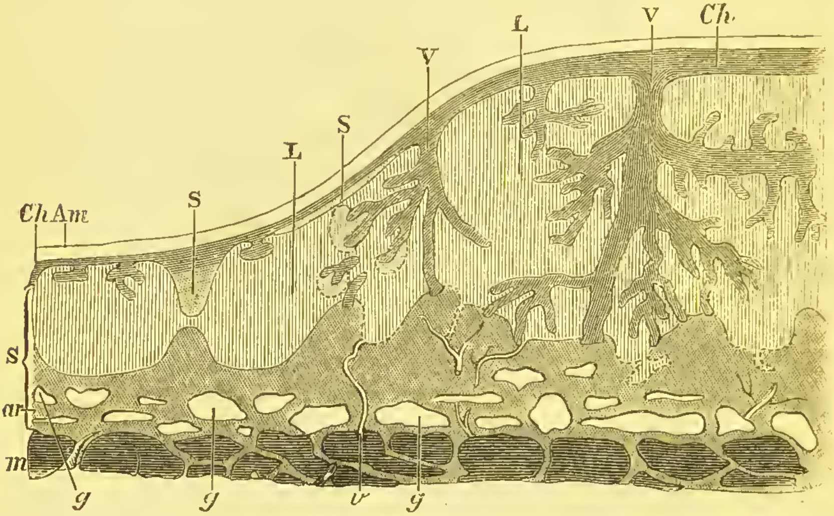

Fig. 46.—Diagrammatic section of placenta. *Am*, amnion; *Ch*, chorion; *m*, muscular wall of uterus; *ar*, areolar layer; V, main trunk of chorionic villi; L, lacuna containing maternal blood; S, decidua serotina, seen in parts lining surface of chorion; *g*, glandular spaces; *v*, vessel. (After Leopold.)

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[*] The following authors may be consulted as to the development and structure of the placenta:—Langhans, Archiv f. Gynäk. I., p. 317, IX., p. 341; Archiv f. Anat. u. Physiol., 1877; Kölliker, "Entwickelungs-Geschichte," Leipzig, 1879; Braxton Hicks, Obst. Trans., XIV.; Turner, Sir W., Journ. Anat. and Physiol., VII., X., Trans. Roy. Soc. Edinburgh, XXVI., XXVII.; "Lectures on Compar. Anat. of Placenta," Edinburgh, 1876; Winkler, Archiv f. Gynäk., IV., p. 238; Leopold, Archiv f. Gynäk., XI., p. 442; Blucher, Archiv f. Gynäk., XIV., p. 121; Ercolani, "Sul processo formativo della Porziona Materna della Placenta," Bologna, 1870; Hart and Gulland, Trans., Edin. Obst. Soc., 1891-2; Eckardt, Ztschr. f. Geburtsh. u. Gynäk., 1890; Rohr, Virchow's Archiv, 1889; Rossmann, Centralbl. f. Gynäk., 1893; Waldeyer, Arch. f. Mickr. Anat., 1890; Webster, Ectopic Pregnancy, 1895; Eden, Journ. of Path. and Bactor., 1896.

inserted lower down in the body of the uterus, either approaching to or overlapping the internal os. Such modes of insertion imply respectively the risk or the certainty of hæmorrhage before delivery, and will be discussed under the head of placenta prævia. The placenta is never inserted upon any part of the cervix. The fœtal or internal surface of the placenta is smooth, and covered by the amnion, which can be easily peeled off up to the insertion of the funis, or for about half-an-inch on to the funis. The umbilical cord is generally inserted about the centre of the internal surface,

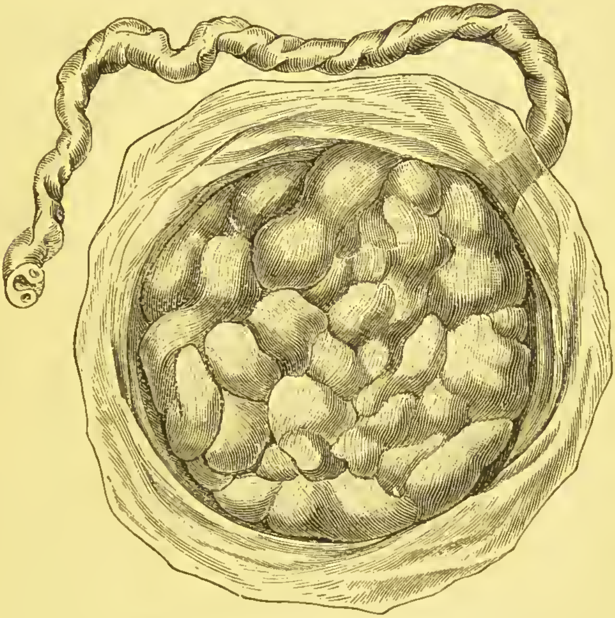

Fig. 47.—Uterine surface of placenta.

and the amnion is reflected over it. Through the amnion large arteries and veins may be seen radiating over the surface from the insertion of the cord (Fig. 48, p. 74). The edges of the placenta are continuous with the chorion and decidua vera.

The external or maternal surface of the placenta, somewhat convex, is slightly rough, compared with the internal surface, and is also soft and friable. It is covered by a very thin greyish-white layer, not more than $\frac{1}{24}$ inch in thickness, formed by the decidua serotina. This is pierced by the openings of the arteries and veins passing between the uterus and the placenta. It may be torn off in places, showing the redder chorionic villi through the gaps. It cannot be stripped off, except in small pieces, owing to the firm attachment to it of the chorionic villi beneath. This external surface is divided by numerous sulci into lobes called cotyledons. The layer of decidua serotina dips down into the sulci, where it is continuous with the decidual processes, which form septa extending into the placenta nearly as far as the surface of the chorion. These decidual processes and their branches form the framework of the placenta, while the greater part of its bulk is made up of the villi. In general to the centre of each cotyledon corresponds a main branch of an umbilical artery, which suddenly dips down at right angles from the fœtal surface. It may be inferred that the centre of the cotyledon corresponded to the centre of one of the primary crypts of mucous membrane into which an early tuft of villi was inserted at the commencement of the development, and the decidual processes surrounding the cotyledon to the ridges which grew up around the crypt. The arteries generally enter at the intersection of sulci, and open at once, or after a very short course, into the placental blood spaces. In their course through the decidua serotina, or, for a short distance, in the decidual processes between the cotyledons, they are destitute of muscular walls, and differ but slightly from veins. The openings for veins are situated on the

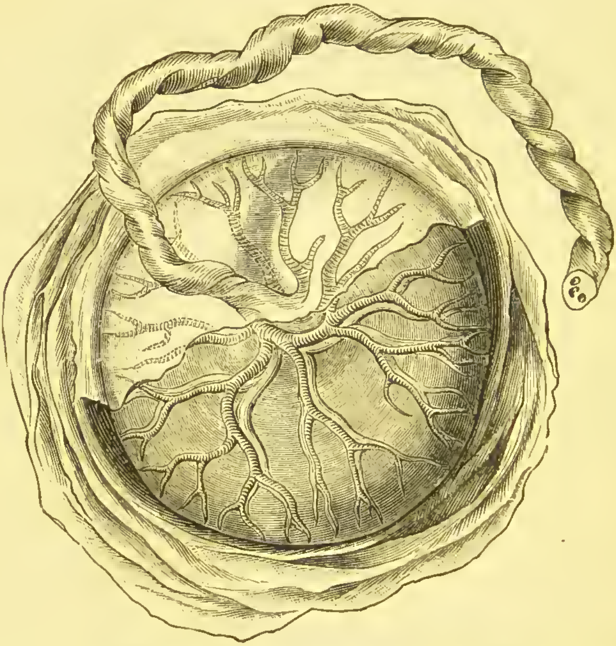

Fig. 48.—Fœtal surface of placenta. Amnion stripped from one half and removed.

sulci. There is also generally described a large sinus, the *circular* or *marginal sinus*, into which many of the venous apertures open, belonging to the decidua vera, and running round the placenta. This, however, is not constant in its presence, nor does it completely surround the placenta.

A certain number of the ramifying branches of the chorion run pretty direct toward the decidua serotina, to which they are firmly attached. In this way the two surfaces of the placenta are held together. The main bulk of the tissue is made up by the exuberant growth of the lateral branches which spring from these. The terminal twig of the umbilical artery in each villus bends down in a loop to become the efferent vein. It is said, however, that the efferent vessel of one terminal villus may become the afferent vessel of another. Numerous capillary networks also exist between arteries and veins in the larger trunks (see Fig. 38, p. 65), and anastomoses between the arteries. Near the margin of the placenta are found villi in which there is little or no vascular development, but which retain their solid cellular character.

If a section be made through the uterus with the placenta *iu situ*, there is seen to be a layer of the decidua serotina just beneath the placenta, in which large flattened spaces are developed. This corresponds to the "areolar or ampullary layer" in the decidua vera, and, like it, forms the surface of separation at full term (*ar*, Fig. 46, p. 72). Some authorities describe a "limiting maternal membrane" very near the fœtal surface of the placenta, and closely applied to the basement chorion from which the main trunks of the chorionic villi spring. Such a membrane must exist if the blood in the sinuses is still contained within the dilated wall of the maternal vessels. Kölliker and Leopold, however, describe it as existing only near the margin of the placenta (*S*, Fig. 46, p. 72). If this account be correct it must be inferred that the wall of the dilating maternal sinuses is completely broken down or becomes indistinguishable, and that the maternal blood is no longer contained within definite vessel-walls at all; or else that the maternal blood-space is extra-vascular from the first.

Some authorities describe, as occurring in the last month of pregnancy, a spontaneous thrombosis in some of the uterine sinuses beneath the placenta, associated with an encroachment on the sinuses by a proliferation of the lining membrane. This has been thought to have to do with the causation of the onset of labour, but is not yet absolutely proved to be a normal occurrence.

Functions of the Placenta.—(1) *Respiration.*—By the interchange of gases between the fœtal and maternal blood, the placenta serves as the respiratory organ of the fœtus, and the blood which reaches the placenta through the umbilical arteries darkened with carbonic acid returns oxygenated through the umbilical vein. Since the fœtus has but little loss of heat to supply, the amount of oxygen required is probably not very great. Nevertheless, experiments on animals have shown that, if the placental circulation be interrupted, the fœtus shows signs of asphyxia in a few minutes,* and the same thing occurs if the funis is compressed in delivery. The fœtus is, however, capable of being restored after a longer duration of asphyxia than an air-breathing animal would survive.

(2) *Nutrition.*—From the time of its formation, the placenta is the sole organ of nutrition for the fœtus, and it is probable that the cells forming the epithelium of the villi have a selective power in absorbing nutriment. That not only substances in solution, but small particles such as microbes may pass from one circulation to the other is proved by the fact that zymotic diseases, especially small-pox and syphilis, are communicated from the mother to the fœtus; for it has been shown that the contagium of such diseases is particulate. In experiments on animals also it has been found that minute particles of cinnabar passed from the maternal to the fœtal circulation.† Various chemical substances administered to the mother have been detected in the fœtal circulation, but it is only those which are highly diffusible, such as chloroform and iodide of potassium, which pass with freedom. Thus opium, or its alkaloids, may be administered to the mother in considerable doses without destroying the fœtus, although young infants are highly susceptible to their influence.

(3) *Excretion.*—It has been shown that the fœtus maintains a temperature of its own slightly above that of the surrounding parts of the mother, and hence tissue changes must take place in it with some activity. The urea and probably other waste products are chiefly got rid of through the placenta, although, to some extent, they are discharged with the fœtal urine into the liquor amnii in the later months of pregnancy. Thus urea has been detected in the blood of the placenta in greater proportion than in other parts of the maternal circulation. Hence the placenta, to some extent, discharges the functions of the kidneys during fœtal life. According to Claud Bernard, it has also a glycogenic function, taking the place of the liver until that organ is sufficiently developed. Both these functions are probably performed by the cells of the villi.

The Umbilical Cord.—The umbilical cord, or funis, forms the link between the umbilicus of the child and the placenta. When fully formed it contains the two umbilical arteries and one vein, originally the left vein, and the remnant of the pedicle of the umbilical vesicle. It is covered outside by the amnion, and the main part of its bulk is made up of a special kind of embryonic connective tissue, called *Wharton's jelly.* This is composed of delicate interlacing fibrillæ, which are processes extending from small stellate cells, and have large interspaces filled with gelatinous muco-albuminoid material. Similar tissue occurring in morbid growths receives the name of myxoma. The thickness of the cord is generally about that of the little finger, but varies considerably, according to the amount of Wharton's jelly present. The average length of the cord is about 20 inches, but it may be as long as 70 inches or as short as 3 inches. In cases of malformation of fœtus, with extroversion of abdominal viscera, the cord may be absent altogether, the fœtus being in contact with the placenta. Excess of length is more frequent than defect. When very long it is liable to form loops round the neck, limbs, or body of the fœtus. Knots may also be formed in it when the fœtus, while small, happens to pass through a loop, but these are rare. If a knot becomes drawn tight, the fœtus may perish from the arrest of circulation.

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* Zweifel. Die Respiration des Fœtus: Arch. f. Gynæk. IX., p. 292.

† Reitz, Centralbl. f. die Med. Wissensch., 1868.

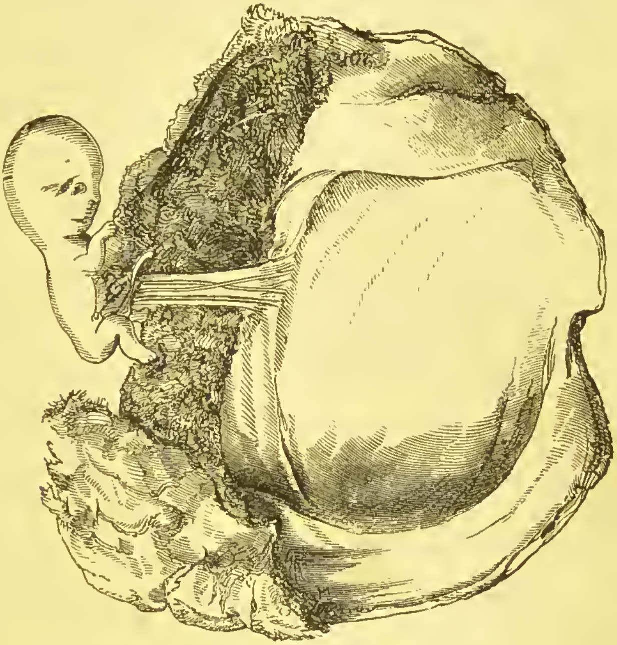

Fig. 49.—Early ovum, of about ten weeks, in the Museum of Guy's Hospital, showing the straight direction of the vessels of the cord.

The amnion is continuous with the skin of the abdomen near the umbilicus, the transition being generally about $\frac{1}{3}$ inch outside the level of the abdomen. Up to the third month the intestine extends a little way into the umbilical cord; at that time it becomes retracted into the abdomen. The arteries are external to the vein which lies between them. They have no branches, and have the peculiarity that they increase in diameter from the fœtus toward the placenta, so that the current of blood becomes slower in approaching the placenta. There are no capillaries in the cord after an early stage of pregnancy, except a few which extend a short distance into it from the skin of the fœtus. But vasa propria of the cord have been described as existing at a very early stage of pregnancy, derived from the umbilical arteries.

Spiral Twist of the Cord.—In early pregnancy, when the cord is short, the arteries run parallel, or nearly so (Fig. 49, p. 77), but at the end of pregnancy there is a spiral twist, which, in about nine cases out of ten, is from right to left. (See Fig. 47, p. 73). This implies that the fœtus must have made a corresponding number of revolutions upon its axis. The cause of the twist has not been satisfactorily explained. It has been ascribed to the mode of growth of the umbilical vessels, or the pressure in them, to the movements of the fœtus, to the action of its heart, or the pressure in its vessels. If it be assumed that the left leg is congenitally stronger than the right, corresponding with the right arm, and that it is used more strongly by the fœtus in kicking, the usual direction of the rotations, and of the consequent spiral in the cord, will be accounted for. Nodosities are often seen upon the cord, due to local dilatation of the veins, or heaping up of Wharton's jelly.

The stature and bulk of the father and mother naturally have an influence. Males are, on the average, heavier than females, the proportion being about 12 to 11. Children generally increase in weight in successive pregnancies. This may depend, in a measure, upon the effect of repeated parturition, but probably in greater degree upon the age of the mother, for it has been found that the heaviest children are born between the ages of 25 and 35. Hence, if there is disproportion between the fœtus and the bony pelvis, later labours are often more difficult than the earlier ones. Beyond the age of 35, the weight of the children tends again to diminish. For two or three days after birth, and before the secretion of milk is fully established, the child loses weight. The number of boys born exceeds that of girls in the proportion of about 106 to 100.

Circulation of the Fœtus.—The umbilical vein, which brings the aërated blood from the placenta, divides at the transverse fissure of the liver into two branches. The larger of these unites with the portal vein, and supplies the liver; the lesser, the *ductus venosus*, passes directly to the inferior vena cava. Thus the greater part of the aërated blood has to pass through the liver before reaching the general circulation, and this proportion becomes greater towards the latter part of pregnancy. The right auricle receives from the inferior vena cava a mixture of venous blood from the lower parts of the body with aërated blood from the placenta, either direct or after passing through the liver.

In the earlier months of fœtal life, the blood current of the inferior vena cava is directed by the Eustachian valve across the right auricle, through the foramen ovale into the left auricle, and thence to the left ventricle. The venous blood returning from the upper part of the body by the superior vena cava, passes in front of the Eustachian valve, through the right auricle into the right ventricle. Thence it is driven into the pulmonary artery, whence only a small proportion passes to the lungs, while the major part passes through the ductus arteriosus into the aorta beyond the point of origin of the left subclavian artery, and so is distributed to the lower part of the body.

Thus in the earlier part of fœtal life, while the Eustachian valve almost entirely prevents a mixing of the currents in the right auricle, the head, neck, and upper extremities are supplied with almost pure aërated blood, the lower part of the body only with venous blood which has already passed through the other part of the circulation. Thus is explained the disproportionately rapid development of the head and upper part of the body, more especially in the early part of fœtal life.

A change, however, takes place by about the middle of pregnancy.

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The Eustachian valve becomes smaller, and the valve of the foramen ovale becomes more developed, so that a portion of the aërated blood entering from the inferior vena cava is retained in the right auricle, and

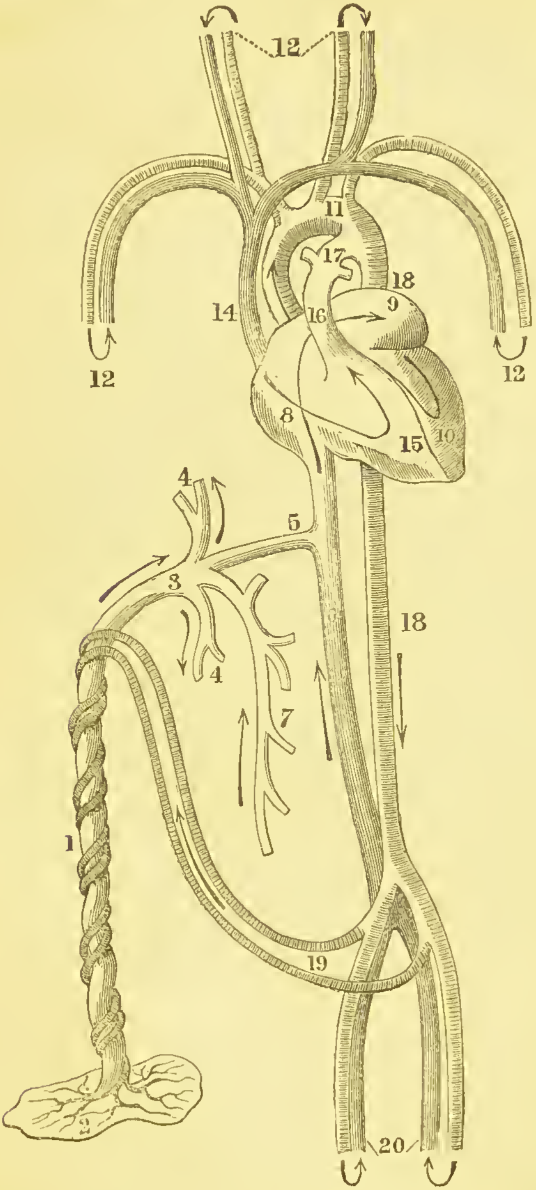

Fig. 51.—Diagram of the fœtal circulation. 1, the umbilical cord, consisting of the umbilical vein and two umbilical arteries, proceeding from the placenta (2); 3, the umbilical vein dividing into three branches—two(4,4) to be distributed to the liver, and one (5) the ductus venosus, which enters the inferior vena cava (6); 7, the portal vein, returning the blood from the intestines, and uniting with the right hepatic branch; 8, the right auricle—the course of the blood is denoted by the arrow proceeding from 8 to 9; 9, the left auricle; 10, the left ventricle—the blood following the arrow to the arch of the aorta (11), to be distributed through the branches given off by the arch to the head and upper extremities; the arrows (12) represent the return of the blood from the head and upper extremities through the jugular and subclavian veins, to the superior vena cava (14), to the right auricle (8), and in the course of the arrow through the right ventricle (15) to the pulmonary artery (16); 17, the ductus arteriosus, which appears to be a proper continuation of the pulmonary artery—the offsets at each side are the right and left pulmonary arteries cut off; the ductus arteriosus joins the descending aorta (18, 18), which divides into the common iliacs, and these into the internal iliacs, which become the umbilical arteries (19), and return the blood along the umbilical cord to the placenta, and the external iliacs (20), which are continued into the lower extremities. The arrows at the termination of these vessels mark the return of the venous blood by the veins to the inferior cava. (After Carpenter.)

reaches the descending aorta by way of the ductus arteriosus. Hence, in the latter half of pregnancy, the lower part of the body is supplied, no longer with venous, but with mixed blood, while the head and upper limbs are still supplied with comparatively pure aërated blood. This explains the fact that a relatively more rapid growth of the lower part of the body takes place in the latter half of pregnancy than in the former.

Changes in the Fœtal Circulation at Birth.—As soon as the child is born an immediate change takes place in the circulation. As soon as the first respiratory movements take place, and air enters the lungs, the pulmonary arteries immediately dilate, and a greatly increased stream of blood passes through the lungs, and, returning to the left auricle, raises the pressure in it. At the same time the placenta is detached, the circulation through it soon ceases, and, by the cessation of the current from the umbilical vein, the pressure in the right auricle is lowered. The two causes combined render the pressure in the left auricle greater than that in the right, the valve of the foramen ovale is thereby closed and blood no longer passes between the auricles. Moreover, as soon as the main stream of blood propelled by the right ventricle begins to pass through the lungs, the pressure in the ductus arteriosus is lowered. The ductus is then gradually diminished by the contractility of its own walls, and, at the end of a few days, is practically closed, though not absolutely obliterated for some time longer. The walls come into contact and adhere without the formation of any thrombus. The aortic end of the duct is the last to contract, the pressure in the aorta being now greater than that in the pulmonary artery.

The edges of the valve of the foramen ovale also generally become adherent and unite after a few days. The opening may remain ununited, however, for some little time without any blood passing through it. A patent condition of the opening after birth is one of the causes of cyanosis in infants.

The pressure in the descending aorta becoming diminished when it no longer receives blood through the ductus arteriosus, the umbilical arteries also contract to some extent, thrombi are formed in them, and they become obliterated. The umbilical vein is also closed either by simple contraction or by thrombus.

Function of the Liver.—It is evident that the liver has an important function in fœtal life, since its relative weight is so much greater than after birth. Sugar is found in the fœtus in larger quantities than after birth, and the glycogenic function of the liver is doubtless an important one from the time of its development. The sugar is found, however, even earlier than this; and, at this stage, the glycogenic function appears to be fulfilled by other tissues, especially by the placenta. About the fifth month the liver cells begin to assume their characteristic features, and bile to be secreted. Bile has already been mentioned as a constituent of the meconium. The gall-bladder is also generally filled at the time of birth.

Nervous System.—The brain cells of the fœtus are in a rudimentary condition up to birth. There is however a discharge of energy from time to time causing the movements of the limbs. Reflex movements are also provoked by stimulus applied to the surface of the body. They are easily excited by pressure through the walls of the abdomen and uterus, and may also be called out by uterine contractions, when the fœtus is so placed that contraction causes pressure on any special parts.

CHAPTER VI.

THE ANATOMY OF THE FŒTAL HEAD.

The head of the fœtus is the part which, in almost all cases, passes with greatest difficulty through the pelvis; and the behaviour of the head during its passage must of course depend upon the mutual relations between the head and the pelvic cavity. In order, therefore, to understand the mechanism of labour it is as necessary to study the anatomy of the fœtal head as that of the pelvis.

The head of the fully developed fœtus forms an irregular ovoid, whose compressibility varies greatly according to the diameter in which the compressing force is applied. In reference to midwifery, the head may be regarded as made up of two parts, the incompressible base, including the bones of the face, and the compressible vault or calvarium. The bones of the base of the skull and face are early developed, so that by the time of birth they are practically unyielding in their texture, and for the most part immoveably united to each other. In consequence of this the various important ganglia and organs of special sensation at the base of the brain are protected from injury, as the head is compressed during labour. The bones which make up the calvarium, on the contrary, instead of being ossified together as in later life, are connected only by membrane, while the bones themselves, in the great majority of cases, are soft and semi-cartilaginous, especially towards the edges. The individual bones are thus moveable and may be made to overlap each other to a considerable extent. The shape of the head can be altered by moulding, according to the exigencies of the case, not only by this relative movement and overlapping of the bones, but still more by actual bending of the bones themselves, more especially of the parietal bones, which are the softest. The effect of the pressure on the head during labour is to diminish the capacity of the whole cranium. This is proved by the rapid increase of the average diameters of the fœtal head which takes place during the first two or three days after birth, at a time when the weight of the whole child is actually diminishing. It is brought about mainly by cerebro-spinal fluid being squeezed out of the head into the spinal canal, but, to some extent also, by the blood being similarly squeezed out into the veins of other parts. The brain substance of the hemispheres, being but little developed at the time of birth, is able to undergo considerable compression and moulding without permanent injury. As the head becomes compressed, the parietal bones invariably overlap, or tend to overlap, both the frontal and occipital bones. It will be seen hereafter that a knowledge of this fact is of very practical importance in facilitating the diagnosis of the position of the head in vertex presentations. The parietal bone which is anterior in the pelvis generally overlaps the posterior in vertex presentations, because it receives less support from the soft parts.

ANTERIOR

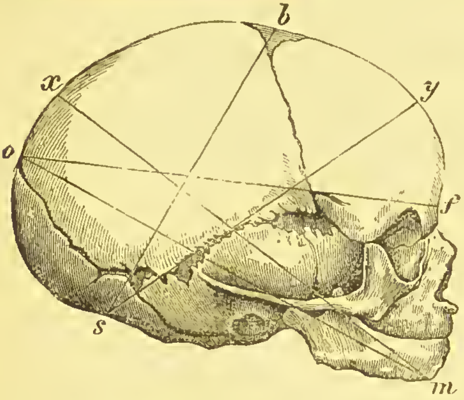

Fig. 52.—Fœtal skull. *o—f*, occipito-frontal diameter; *o—m*, occipito-mental; *m—x*, maximum vertico-mental diameter; *s—b*, suboccipito-bregmatic; *s—y*, suboccipito-frontal.

The face, as compared with that of the adult, is very small in proportion to the cranium. The lower jaw especially is widely different from the adult maxilla, the ramus being short and oblique, so that the toothless maxillæ come into close contact, and both chin and angle of jaw are approximated to the forehead. Thus the distance from the tip of the chin to the root of the nose measures only from 1¼ to 1½ inches.

The Sutures and Fontanelles.—The vault of the skull is made up mainly of four bones, the occipital, the two parietal, and the frontal, which at the time of birth is divided in the median line into two parts. The squamous portions of the temporal bones form such a small proportion of the vault that they scarcely come into consideration. The membranous septa between the bones are called *sutures*, the points at which two or more sutures meet are called *fontanelles*. Looking at the head from above (Fig. 53, p. 89), the four sutures which are of chief importance are seen. These are:—1st, the *sagittal*, which separates the two parietal bones, and divides the vertex longitudinally. It derives its name *sagitta*, an arrow, because it is the principal direct and symmetrical suture. 2nd. The *frontal* suture is a continuation of the sagittal suture forwards, and separates the two halves of the frontal bone. 3rd. The *coronal* suture separates the frontal from the parietal bones: it extends transversely and almost vertically across the head, meeting at its extremities the temporal sutures at about the summit of the squamous portions of the temporal bones. It receives its name as marking about the position at which the anterior part of the triumphal crown of the ancients rested. 4th. The *lambdoidal* suture separates the angular projection of the occipital bone from the posterior borders of the two parietal bones, and receives its name from the resemblance of its shape to that of the Greek letter Λ. It extends at each side to the posterior angle of the temporal bone. The temporal sutures, separating the inferior concave borders of the parietal bones from the squamous portions of the temporal bones, have no practical obstetric importance.

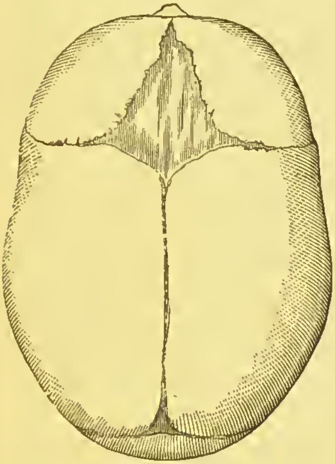

Fig. 53.—Fœtal head, seen from above, showing anterior and posterior fontanelles.

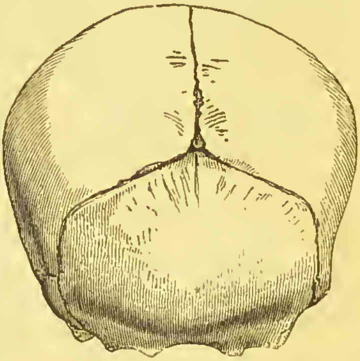

Fig. 54.—Fœtal skull. Posterior view, showing posterior fontanelle, sagittal and lambdoidal sutures.

There are two fontanelles of importance, the *anterior* and *posterior.* The *anterior*, or greater fontanelle, called also the bregma (βρέγμα, the top of the head), is formed by the junction of the sagittal, frontal, and coronal sutures. It forms a wide rhomboidal membranous space, large enough for the tip of the finger to be laid in it ; its anterior angle running between the divisions of the frontal bone, extends much further than the others (Fig. 53).

The *posterior* fontanelle (Fig. 54) is formed by the junction of the sagittal and lambdoidal sutures. It does not form an open membranous space like the anterior, unless there is defective ossification, but it is recognised simply as the point of junction of three converging sutures, the sagittal and the two branches of the lambdoidal. If in any case it should approximate in size to the anterior, it is easily distinguished from it, if it be remembered that the anterior fontanelle is formed by the junction of *four* sutures at right angles, the posterior by the junction of *three* sutures, inclined at an angle of about 120° to each other. Occasionally, a false fontanelle is formed by a spot of defective ossification along the course of one of the sutures, generally the sagittal. It is distinguished by the fact that only two lines of suture can be traced from it. Sometimes mention is made of temporal fontanelles, at the anterior and posterior extremities of the concave inferior border of each parietal bone (Fig. 52, p. 88). Of these, the anterior is never of any consequence, being covered by the temporal muscle. The posterior temporal might possibly be mistaken for the posterior fontanelle if the head were greatly flexed, and at the same time flexed also laterally, so as to bring its side within reach. It would, however, be readily distinguished by its being easy to feel the ear in its immediate proximity.

Besides the change of shape of the head which is allowed by the bending and overlapping of the several bones forming the vault of the skull, a further moulding is permitted by the fact that the triangular portion of the occipital bone, which is a component of the vault, is united to the basilar portion, not rigidly, but by a fibro-cartilaginous band. In this way a kind of hinge-joint is formed, allowing the posterior portions of the bone to perform movements of flexion and extension.*

The fœtal head often becomes unsymmetrical in consequence of the moulding which it undergoes during labour. A slight degree of deviation from symmetry may, however, be observed in a fœtal head which has been removed from the uterus either by Cæsarian section, or after the mother's death, and has never undergone the process of labour. This has been ascribed to a natural asymmetry, which arises during development, and is of such a nature that there is a slight tendency to a spiral arrangement throughout the whole spinal column, involving both the head and the pelvis. So far as regards the head, it is generally of such a kind that the right side appears to be slightly displaced downwards and forwards, the left side upwards and backward, in reference to the vertical axis of the fœtus.†

Diameters of the Fœtal Skull.—In order to judge of the changes of shape of the head, and its relations, both before and after moulding, to the dimensions of the pelvis, it is desirable to have numerical measures of some of the more important diameters of the skull. These have been given very variously, and with a want of exactitude, by different authors. Thus the fronto-occipital diameter is by some made to terminate at the posterior fontanelle, by others at the occipital protuberance. The occipito-mental diameter is, by different authors, regarded as starting from either the one or the other of these points, and is generally spoken of as the largest diameter of the skull. Except in a few exceptional cases, it is nothing of the kind according to either definition. The maximum diameter, in the great majority of cases, runs from the chin to a point on the sagittal suture, somewhat variable in position according to the moulding, but nearer to the posterior than to the anterior fontanelle. It is usually, therefore, a superoccipito-mental diameter. Exceptionally, however (in some cases of face and brow presentation), the maximum diameter terminates at a point between the posterior fontanelle and the occipital protuberance, and is, therefore, a suboccipito-mental diameter. It appears better, therefore, with Budin,* to describe a maximum vertico-mental diameter, as distinct from the occipito-mental. Again, the cervico-bregmatic and suboccipito-bregmatic diameters are, by different authors, made to terminate at the centre of the anterior fontanelle, its anterior margin, or a point on the sagittal suture. For these diameters to be of any use in giving information as to the moulding of the head, it is absolutely necessary that they should be measured from points, such as the centres of the fontanelles, which can be accurately determined throughout all stages and varieties of moulding. The important diameters, then, are the following (see Fig. 52, p. 88) :—1st, the maximum vertico-mental (Max.) ; 2nd, occipito-mental (O. M.), measured from the posterior fontanelle to the chin ; 3rd, the occipito-frontal (O. F.), measured from the posterior fontanelle to the glabella, or root of the nose ; † 4th, the cervico-bregmatic (C. B.), measured from the centre of the foramen magnum to the centre of the anterior fontanelle, or point of intersection of the coronal with the line of the sagittal and frontal sutures ; 5th, the sub-occipito bregmatic (S-O. B.), measured from the junction of the occipital bone with the back of the neck to the centre of the anterior fontanelle ; 6th, the sub-occipito-frontal (S-O. F.), measured from the same point to the prominence of the forehead. All these are measured in the vertical antero-posterior plane. The following are transverse diameters:—7th, the bi-parietal (Bi-P.), or maximum transverse, between the two parietal protuberances; 8th, the bi-temporal (Bi-T.) is measured between the points widest apart on the coronal suture; 9th, the bi-zygomatic (Bi-Z.), or maximum transverse diameter of the base of the skull, is measured between the two points widest apart on the zygomata; 10th, the bi-mastoid (Bi-M.), the outside diameter between the mastoid processes at their widest part.* Of these diameters the cervico-bregmatic corresponds approximately with the vertical diameter of the skull. The occipito-frontal does not perfectly correspond with an antero-posterior or longitudinal diameter, which should be rather measured from the occipital protuberance than from the posterior fontanelle. In the unmoulded head the two are almost precisely equal, but in the ordinary moulding of vertex presentations the occipito-frontal becomes the larger. Owing to the flexed position of the head, neither the one nor the other is normally ever coincident with the plane of the pelvic brim.

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* Budin. "De la Tête du Fœtus au point de vue de l'Obstétrique." Paris, 1876, p. 76.

† Stadtfeldt. "On the Physiological Asymmetry of the Head of the Fœtus." Obstet. Journ. VII., p. 92.

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* Op. cit., p. 17.

† This measurement is more commonly taken to the occipital protuberance, but in the unmoulded head, its magnitude is about the same in either case. The position of the occipital protuberance cannot be precisely determined in the living infant.

The following are average measurements for these diameters in the unmoulded head, those in the second column being given to the nearest quarter of an inch, so as to be more easily committed to memory:—

1.	Maximum vertico-mental diameter (Max.)	5 inches,	or 5
2.	Occipito-mental (O. M.)	4·85 ,,	or $4\frac{3}{4}$
3.	Occipito-frontal (O. F.)	4·6 ,,	or $4\frac{1}{2}$
4.	Cervico-bregmatic (C. B.)	3·8 ,,	or $3\frac{3}{4}$
5.	Sub-occipito-bregmatic (S-O. B.)	3·8 ,,	or $3\frac{3}{4}$
6.	Sub-occipito-frontal (S-O. F.)	4·1 ,,	or 4
7.	Bi-parietal (Bi-P.)	3·7 ,,	or $3\frac{3}{4}$
8.	Bi-temporal (Bi-T.)	3·4 ,,	or $3\frac{1}{2}$
9.	Bi-zygomatic (Bi-Z.)	3·1 ,,	or 3
10.	Bi-mastoid (Bi-M.)	3·0 ,,	or 3

After even easy labours, with normal vertex presentation, the diameters of the head will, when the child is born, be somewhat different in relative magnitude from those given above, in consequence of the pressure which the head has sustained. The most marked changes are increase of the maximum vertico-mental diameter, and diminution of almost all the rest, even of the occipito-mental, but especially of the sub-occipito-bregmatic and bi-parietal. The nature of the moulding will be explained in the chapter on the mechanism of labour.

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* A fronto-mental diameter is sometimes mentioned, and estimated at about 3·25 inches, but this is useless, since there is *no* definite point from which to measure its upper extremity.

Influence of Sex and Race on the Dimensions of the Fœtal Head.—The brain of men being, on the average, somewhat more bulky than that of women, there is a corresponding difference in the size of the head of male and female children at birth. The average difference in circumference has been found to be about half an inch, or about one twenty-fifth part of the whole. The bones of the male skull are also generally more firmly ossified at the time of birth. Hence arises greater protraction of labour in the case of males, more frequent necessity for artificial aid, and greater mortality both to mothers and children. Thus, out of more than 47,000 deliveries in the Guy's Hospital Lying-in Charity, the number of children stillborn was, including all presentations, among males 42·8 per 1,000, among females 35·6 per 1,000; while, in vertex presentations at full term, the numbers were, among males 26·9 per 1,000, among females 21·5 per 1,000 stillborn. A greater number of male children than females also die shortly after birth. The size of the child's head, like its total bulk, increases with the age and repeated pregnancies of the mother, in the mode which has been already mentioned (see p. 83).

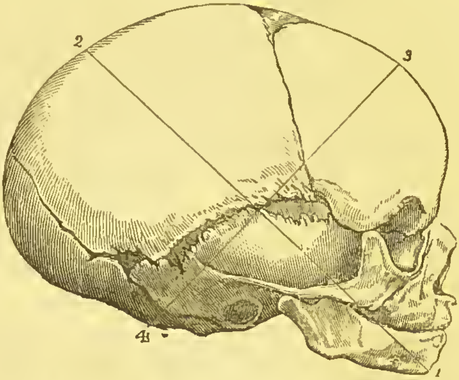


Fig. 55.—Skull of a European fœtus.

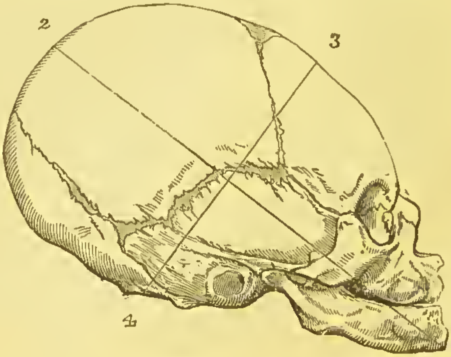


Fig. 56.—Skull of a Negro fœtus.

The influence of race is a still more important one than that of sex. The increase of size in the brain which goes with civilization and intellectual development involves greater pain, difficulty, and risk in parturition, for it requires a corresponding increase of size in the skull, and, although the pelvis undergoes some corresponding enlargement, yet this does not fully keep up with that of the head. In savage races not only is the head smaller on the whole, but there is relatively less development of the anterior cerebral lobes, and the forehead is, therefore, flatter. The sub-occipito-frontal diameter (3–4, Figs. 55, 56), therefore, and also a diameter passing through the prominence of the forehead parallel to the sub-occipito-bregmatic, are much smaller. Labour is, therefore, facilitated in corresponding degree, since this latter diameter, in the living child, has to be taken in conjunction with a portion of the back of the neck, when the head is entering the pelvis with the head well flexed, and thus becomes the largest of all the diameters of the fœtus which is ever coincident with the greatest diameters of the pelvic brim or outlet. In explaining the facility of parturition in savage women, it is necessary also to take into account the greater sensibility to pain induced by the mode of life of the civilized and highly cultivated woman, although the difference in the size of the fœtal head appears to be the most important element. Even in the same race, the size of the head is greater in the educated classes than in the uneducated, and greater also among inhabitants of towns than in agricultural districts. Comparing civilized races with each other, difficult labours are perceptibly more numerous in a race like the Teutonic, in which the type of head is short and round, or brachycephalic, than in one like the Celtic, Scandinavian, or Norman, in which it is more frequently long or dolichocephalic. Some savage races, like the Caribs, and the Macrocephali, a Scythian race mentioned by Hippocrates, have been accustomed to flatten the foreheads of the children by pressure in early infancy, and it has been supposed that a hereditary tendency to such a form of head has eventually been acquired in such cases.

Articulation of the Fœtal Head.—The articulation of the head with the spinal column, allowing movements of flexion and extension, is situated nearer to the occiput than to the forehead, in the proportion of about one to two. The head, balanced upon its condyles, may hence be regarded as a lever, the anterior arm of which is longer than the posterior. The importance of this circumstance, in securing flexion of the head, will be seen hereafter. Movements of rotation take place between the atlas and axis, and the head can generally be rotated upon the body through as much as a quarter of a circle without injury to the spinal cord.

CHAPTER VII.

THE ATTITUDE, PRESENTATION, AND POSITION OF THE FŒTUS IN UTERO.

By the *attitude* of the fœtus is meant the relation which the different parts of its body have to each other. By the *presentation* is meant the part of its body which occupies the lower segment of the uterus, lying over the internal os uteri; this is determined by the relation which the long axis of the fœtus has to that of the uterus. By the *position* is meant the relation which any part of the fœtus (*e.g.* the back) has to the front, back, and sides of the uterine walls. Thus the back may be inclined backward or forward, to the right or to the left. Hence for each presentation of the fœtus there are varying positions, and it is usual to divide these into four, with reference to two axes or straight lines intersecting the longitudinal axis of the uterus at right angles to that axis and to each other, and thus dividing the uterus, or the pelvic brim, into four compartments. The corresponding positions are called the

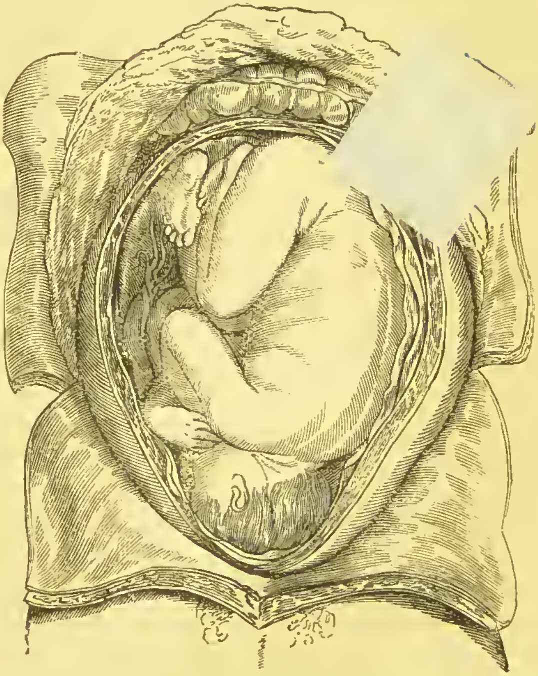


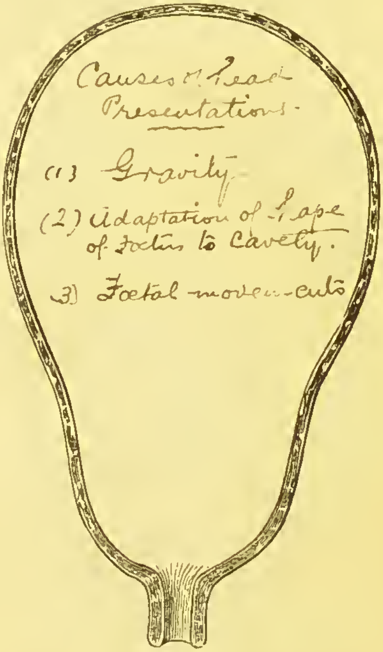
Fig. 57.—Attitude of the mature fœtus *in utero.*

first, second, third, and fourth, and will be described hereafter in reference to each presentation.

Attitude.—The usual attitude of the fœtus is as follows (Fig. 57, p. 95, Fig. 60, p. 98):—The back is arched, so as to form a convexity backward. The head is bent upon the sternum. The forearms are crossed, or close to each other in front of the chest. The thighs and legs are flexed, so that the knees are near the elbows and the heels near the breech or buttocks, the dorsum of the foot being drawn up toward the leg, and the sole turned somewhat inward. The legs are generally crossed. The umbilical cord generally lies in the space between the arms and legs. This attitude exists more or less from the early part of pregnancy, but in the earlier months, when the liquor amnii is relatively in greater quantity, the limbs have greater freedom of movement, and are not so close to the body (Fig. 60, p. 98). The attitude is due to the tonic action of the flexor muscles, which, as being the stronger, predominate over the extensors. A tendency toward a similar position of the limbs is seen in the infant even after birth. At the very earliest stage of pregnancy the embryo hangs by the umbilical cord, not touching the walls of the ovum, with its back downward, and its cephalic extremity somewhat lower than the other.

Presentation.—With regard to its presentation the fœtus in the great majority of cases lies with its head downward, that being the position in which its shape is most conveniently adapted to the shape of the uterine cavity, which is most spacious at the fundus (see Fig. 58, p. 97). At the end of pregnancy the proportion of cephalic presentations is as much as 96 per cent. In the Guy's Hospital Lying-in Charity, out of 23,800 children, it was 96·9 per cent. It was for a long time believed that up to about the seventh month of pregnancy the fœtus lay with its head uppermost, and that then by an active movement of its own, which was called the *culbute*, it suddenly reversed its position. It is now established that the head is generally lower than the breech, even from the commencement of pregnancy. In the earlier months frequent changes of position take place through the fœtal movements, and even up to the later months the proportion of head presentations is not so great as at full term. Thus, according to Churchill, at the seventh month the proportion of head presentations is, among living children, only 83 per cent., and among dead children only 53 per cent. Dubois gives 83 per cent. as the proportion of head presentations for living children, and only 45 per cent. for dead children, born during the seventh month. Collins, in about 16,000 deliveries, found the proportion of head presentations among living children 98·3 per cent., among children born in a putrid state, upwards of 500 in number, only 80 per cent. These figures show also that the proportion of head presentations is much less among dead children than among living at the same period of pregnancy.

Changes from other presentations into head presentations are more frequent than the converse, and a transverse or oblique is more frequently changed than a breech presentation. Although changes from the head into a breech or transverse presentation are relatively more rare, yet they do not unfrequently occur, and a fœtus has been observed to change its position from head to breech and *vice versâ* as many as six times within a few days. The chief causes of such changes are strong movements of the fœtus occurring in conjunction with a changed posture of the mother. Valenta, from repeated observations made on nearly 1,000 pregnant women, found that changes of presentation occurred in 42·4 per cent. in the later months of pregnancy.* The presentation becomes progressively more stable as the end of pregnancy approaches, more especially in primiparæ, in whom the head rests lower in the pelvis, while the firmer abdominal walls prevent so much swaying over of the fundus uteri as the position of the body is changed. Schrœder, however, from observation on 214 primiparæ (including 4 cases of contracted pelvis) during the last three weeks of pregnancy, found that changes of presentation took place in 36·4 per cent. The instability of the presentation is much greater when any deformity of the mother exists, especially when there is a contracted pelvis, which keeps the fœtal head entirely above the brim.



Causes of Head Presentations.

(1) Gravity

(2) Adaptation of shape of foetus to cavity.

3) Foetal movements

Fig. 58.—Outline of the ovoid uterus.

Causation of Head Presentation.—There are three chief causes to which the preponderating frequency of head presentation is to be attributed: 1st, the effect of gravity; 2nd, the adaptation of the shape of the fœtus to that of the uterine cavity: and 3rd, the effect of fœtal movements excited by pressure when the two shapes do not correspond. Some controversy has taken place as to which of these is the true cause, but the more correct view is to regard them all as having an influence. As the fœtus is immersed in fluid not much lighter than itself, the effect of gravity will depend, not upon the position of its centre of gravity when in air, but upon the relative specific gravity of its different parts. Dr. Matthews Duncan has shown that the specific gravity of the fœtal head is greater than that of the decapitated trunk. Accordingly when the fœtus is immersed in saline fluid of about the same specific gravity as itself, it lies in an oblique position, its head lower than the breech, and the right side lowest owing to the weight of the liver. If allowed to sink, the right shoulder generally touches the bottom first. Within the uterus the fœtus is not suspended by the umbilical cord, except at the very earliest stage of pregnancy, but rests on the inclined plane formed by the uterine wall. When the woman is standing upright it rests on the anterior uterine wall, inclined to the horizon at an angle of about 35°, the normal pelvic inclination being somewhat diminished during pregnancy in order to preserve the balance of the body. Under these circumstances the usual

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* Monatsschrift f. Geburt. 1866.

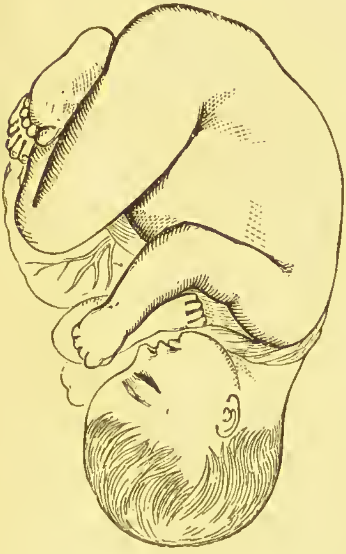

Fig. 59.—Ovoid form of fœtus at full term.

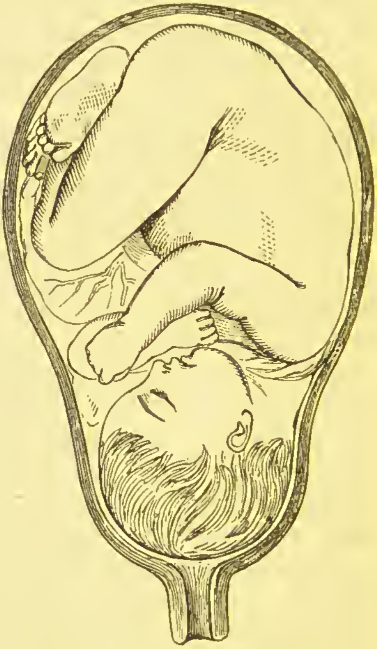

Fig. 60.—Adaptation of fœtus to uterus.

position of the fœtus is almost exactly that which it assumes when immersed in saline fluid. Again when the woman is lying flat on her back, the fœtus rests on the posterior uterine wall, inclined at an angle of about 55° to the horizon. In this position also gravity favours head presentation, but tends to rotate the back of the fœtus towards the mother's back. In the reclining position, when the shoulders are raised, the axis of the uterus is nearly vertical, and the extra specific gravity of the head tends still further to keep it over the os. When, however, the woman lies on her side, the fundus uteri drops over by its own weight, and then gravity tends to displace the head from the os. The gravitation theory accounts for head presentations being less usual with dead children, for Dr. Duncan has found that when the child has died in utero before labour, the specific gravity of the head is less than in the case of a living child, and the fœtus often floats with the head highest in a saline fluid of its own specific gravity.

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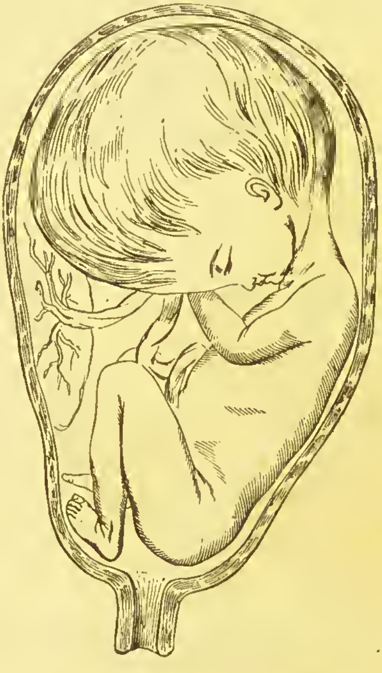

Fig. 61.—Adaptation of hydrocephalic fœtus.

EPHALUS Again, it is found that in cases of hydrocephalus the occurrence of presentations other than that of the head is about nine times as frequent as it is with healthy children. This is explained in a measure by the fact that the specific gravity of the hydrocephalic head is probably less than that of the healthy head notwithstanding the increase of its total weight. In this case, however, the question of adaptation of shape comes also into play; the enlarged head does not so readily fit into the lower segment of the uterus; and when the enlargement is very great, the shape of the fœtus may be best adapted to that of the uterus when the head is uppermost (see Fig. 61). The chief reason for thinking that the effect of gravity is not sufficient by itself to account for all the circumstances is found in the fact that the head presents more frequently than other parts, even when women are constantly lying in bed, and as frequently on the side as on the back.

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In the later months of pregnancy the shape of the uterine cavity is definitely pyriform, with the broad end uppermost (see Fig. 58, p. 97), and this is especially the case when its walls become rigid under the influence of the occasional muscular contractions which are constantly taking place throughout pregnancy. The shape of the fœtus in its usual attitude is also pyriform, and corresponds to that of the uterus when the head is downwards. When the long axis of the child is transverse or oblique, the pressure of the contracting uterine wall tends to press the projecting poles towards the central axis of the uterus, and so convert the presentation into a head or breech. At the same time the pressure thus exerted upon the fœtus is likely to excite reflex movements, which assist in changing the position. In breech presentations (Fig. 62), the fœtus is not so well adapted to the uterine cavity as in cephalic, the lower segment of the body of the uterus being unduly distended. It is not likely that the uterine contractions would by themselves change such a presentation, but the fœtus is not so stably held in position by the uterine walls as when the head is downwards, and it is probable that the increased pressure on the legs may excite more lively movements than usual, and increase the chances of a change of presentation. All changes occur more easily when the liquor

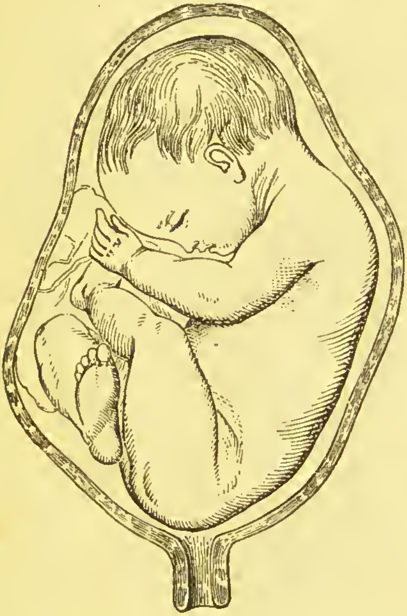

Fig. 62.—Adaptation of fœtus and uterus in breech presentation.

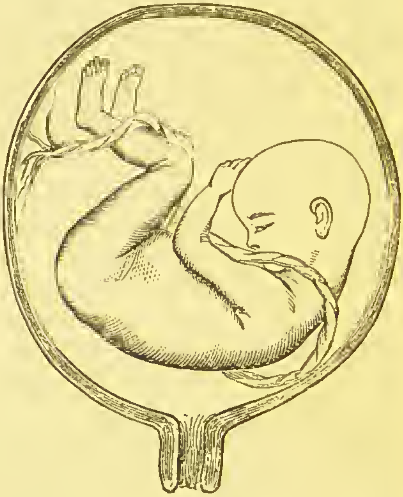

Fig. 63.—Fœtus in utero at fifth month.

amnii is relatively abundant, and after the rupture of the membranes it is rare for a change of presentation to occur. That such a thing is a possibility, however, is shown by the occurrence of the so-called spontaneous version in some cases of shoulder presentation.

When the child is dead the effect of reflex movements is lost, and the long axis of the child has no longer the same tonicity. These influences must be added to that of the changed specific gravity of the head in accounting for the frequency of abnormal presentations with dead children. In the earlier months of pregnancy the uterine cavity is more spherical, and the relative abundance of liquor amnii allows the fœtus to lie in it in almost any position (see Fig. 63, p. 100). An abnormal presentation is also more easily produced by the gush of liquor amnii on rupture of the membranes.

CHAPTER VIII.

CHANGES IN THE MATERNAL ORGANISM CONSEQUENT UPON PREGNANCY.

Changes in the Uterus.—From the commencement of pregnancy an increased nutritive energy is imparted to the sexual apparatus, including the breasts, and to surrounding parts, but more especially, and in enormous degree, to the body of the uterus, which serves as a receptacle for the ovum. The nulliparous uterus weighs about an ounce, that of the woman who has borne children about an ounce and a half; at the full term of pregnancy it weighs twenty-eight ounces or more, not including the blood contained in its walls, while the fœtus is still in its cavity. The length of the uterine body is increased from about 1½ inches to about 12 inches, its width from 1½ inches to about 9 inches. The cavity, which in the nulliparous uterus is almost flattened, and has cubical capacity only sufficient to contain a few drops of mucus, is increased at its full development to five hundred or more cubic inches. The following table gives the average dimensions at different months according to Farre and Tanner:—*

	Length.	Width.	Depth.
End of 3rd month	4½— 5	4	3
4th	5½— 6	5	4
5th	6 — 7	5½	5
6th	8 — 9	6½	6
7th	10 —11	7½	6½
8th	11 —12	8	7
9th	12 —14	9½	8—9

This growth affects all the elements of the uterus—the mucous membrane, the muscular walls, the peritoneal covering, the arteries, veins, nerves, and lymphatics. The growth of the mucous membrane by which the decidua is formed has already been described. The increase of the area of the muscular wall is in great measure due to growth rather than distension by the ovum within the first three months of pregnancy, for, at this time, the uterine cavity is not completely filled by the ovum, and an almost corresponding growth of the uterus takes place in that early part of pregnancy in cases of extra-uterine fœtation, when the ovum is not inside the uterine cavity. In the later months distension has more influence, and the muscular wall no longer increases in thickness, but becomes somewhat thinner than before. Its thickness at full term varies much in different cases, and thus accounts for great varieties in the expulsive power of the uterus. It generally varies from $\frac{1}{3}$ to $\frac{2}{3}$ inch, except over the placental site, where it is greater.

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* "Cyclopædia of Anatomy and Physiology," article, "Uterus and its Appendages," p. 645.

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A marked change in the tissue of the muscular wall takes place by the development of enormous involuntary muscular fibres, often as much as ten times the length and five times the thickness of those seen in the unimpregnated uterus. These may arise in part by the growth of the original muscular fibres, but partly also by the development of the embryonic nucleated muscular fibre-cells, having a length not much greater than their thickness, which exist in the unimpregnated uterus. These are shown at 1, 2, in Fig. 64, and the process of development of the large fibres at 3, 4, 5. The length of the developed fibres is as much as $\frac{1}{40}$ or $\frac{1}{50}$ inch. The intermediate cellular tissue is developed with the muscular fibres.

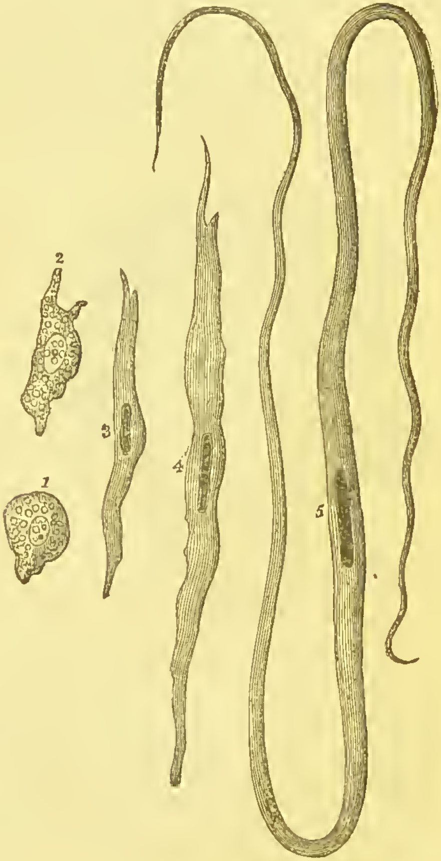

Fig. 64.—1, 2, Embryonic nucleated muscular fibre-cells of the unimpregnated uterus. 3, 4, 5, Muscular fibre-cells of the gravid uterus in different stages of development.

The distribution of muscular fibres in the unimpregnated uterus is confused, so that no definite layer or arrangement can easily be made out. At the full term of pregnancy three muscular layers are described, but these are not so definite or so easily separable as the circular and longitudinal layers forming the walls of other hollow viscera, as the intestines. The external layer is thin, and consists mainly of longitudinal and transverse bands, the longitudinal arranged on the back and front of the uterus, the transverse spreading towards the sides and extending over the broad ligaments, while towards the lower part of the uterus they surround that organ (Fig. 65). The middle layer is the thickest and strongest, especially towards the fundus of the uterus. It consists of fibres which interlace in various directions and surround the uterine arteries. They must therefore diminish the calibre of the arteries by their contraction; and when the emptying of the uterus allows a more complete retraction of the fibres and shrinking of the uterine wall, they close the canals of the vessels entirely, and so prevent hæmorrhage after the separation of the placenta. The internal layer is comparatively thin. The fibres are arranged circularly round the axis of the uterus at its centre and lower part, but at the upper part circularly round the orifices of the Fallopian tubes. Hence this coat in the upper part of the body of the uterus may be regarded as the analogue of the circular muscles surrounding the two horns of the uterus in those animals which possess a uterus bicornis. According to William Hunter, even the internal coat loses its regularity at the placental site, and the fibres are there interlaced irregularly around the vessels, the effect of which arrangement in the arrest of hæmorrhage is obvious. A strong circular band of fibres surrounds

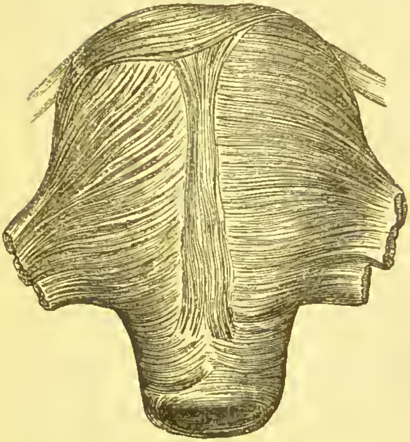

Fig. 65.—External layer of muscular fibres of gravid uterus.

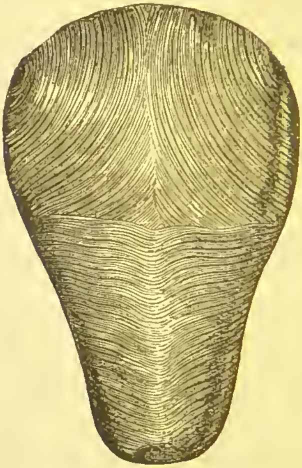

Fig. 66.—Internal layer of muscular fibres of gravid uterus.

the internal os uteri, and forms a true sphincter to the uterine cavity, being much stronger and more ready to contract than any other part of the circular fibres. This sphincter muscle is more manifest clinically than it is on dissection. In the unimpregnated uterus it often leaves its impression as a tight constriction round a laminaria tent used for dilatation: throughout pregnancy, according to the modern doctrine, it holds its ground, and remains closed for the most part, though it may dilate enough to admit the tip of the finger in the last month or two. Even in labour it may show undue spasmodic rigidity, when it ought to relax. After delivery it is the first part to close, while the cervix still remains quite thin and flaccid, and may enclose thereby a retained placenta.

Uterine Vessels.—The main arteries supplying the uterus become greatly enlarged, and so also do those in the uterine walls, especially at the placental site. The coats of the arteries are hypertrophied and thickened, and a considerable remnant of such thickening appears to remain even after involution, and to furnish a character distinguishing the parous from the nulliparous uterus. The arteries ramifying in the uterine walls anastomose freely with each other. As they penetrate deeper into the walls and approach the internal surface, they take a spiral or corkscrew-like course. This is especially marked in the arteries which convey blood into the placenta, and it has the effect of facilitating the closure of the canals by the contraction of the uterine muscular fibres. (See Fig. 42, p. 69.) The veins are still more enlarged, and become dilated into a system of sinuses communicating with each other, chiefly towards the internal surface of the uterus, and more especially under the placental site. (Figs. 45, p. 71; 46, p. 72.) Some of these may be large enough to admit the tip of the finger. The veins have no valves and their walls are not separable from the uterine tissue. Their course is generally parallel to the surface, and is occasionally bent back suddenly upon itself, producing what has been called a "falciform valve." This arrangement allows the vessel to be closed by uterine contraction. In the absence of uterine contraction, it is obvious that hæmorrhage may take place from the veins as well as from the arteries, to very considerable amount.

Uterine Lymphatics and Nerves.—The abundant lymphatics of the uterus form plexuses of lymph spaces, more especially around the glands and vessels of the mucous membrane, and beneath the serous covering of the organ. This lymphatic system undergoes great enlargement in pregnancy, and doubtless fulfils an important function both in the tissue changes attendant upon the rapid growth of the uterus, and still more in its rapid involution after delivery. The great development of lymphatics also accounts for the proneness to absorption of septic matter which exists after delivery.* A great controversy formerly took place as to whether or not the nerves of the uterus grew during pregnancy. It is now established that, as might be expected, growth does take place in the nerves, including the so-called "ganglion cervicale uteri," to fit the uterus for the process of labour, in which both reflex action and periodic centric discharge of nervous energy play important parts. Even during pregnancy, the irritability of the uterus is considerably increased. Uterine contractions, generally painless, are readily excited by stimulus, and such contractions take place at intervals even without any stimulus. The contractions are of service in promoting the circulation through the uterine walls by emptying from time to time the large venous sinuses. Their importance as regards the diagnosis of pregnancy will be further explained hereafter.

Size of the Uterus in the successive months of Pregnancy.—In the first three months the body of the uterus grows more in its breadth and depth than in its length. Hence the pyriform shape of the organ, though maintained to some extent throughout the first three months, is gradually lost. By the end of the third month the whole uterus has become more globular, the growth of the cervix being trifling compared with that of the body, and it retains this globular or egg-shaped form up to the sixth month (see Fig. 63, p. 100). From the sixth month onwards, the fœtus in its usual attitude begins to be accommodated to the shape of the uterus, instead of floating in any position, and to correspond with this necessity, the growth of the long diameter of the uterus again predominates, and the organ again acquires a pear-shaped form, the lower segment generally containing the fœtal head. In abnormal presentations of the fœtus and deformities of the spine or pelvis, the shape of the uterus may be considerably modified. In the first three or four months, the weight of the fundus causes an increase of the normal slight antiflexion of the unimpregnated uterus. About the fourth month the uterus usually first comes into contact with the abdominal walls, and is readily detected on external examination of the abdomen, although its increased size may be detected on bimanual examination at a very early stage. Soon after the end of the fifth month, its upper limit reaches the level of the umbilicus, at the seventh month it is halfway between the umbilicus and the edges of the ribs, in the early part of the ninth month it reaches the epigastrium and is close to the edge of the ribs. During the last two weeks its upper limit becomes somewhat lower when the woman is standing upright, the whole uterus sinking deeper into the pelvis.

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* It is maintained by Dr. Hoggan (Obstet. Trans. XXIII.) that the usual account of the lymphatics of the uterus is erroneous, that there are no true subserous lymphatics, and that the method of injection, by which such a system is supposed to be demonstrated, is fallacious. He describes only a deep and superficial layer of lymphatics in the mucous membrane, and muscular lymphatics, which occasionally appear under the serous surface.

Owing to the pelvic inclination, the pregnant uterus in the later months, when the woman is standing upright, rests upon the anterior abdominal wall as an inclined plane, and the abdominal wall supports a greater share of its weight than the pelvis. The uterus being flaccid in the absence of contractions, its shape is affected by gravity, and thus, both in the upright and dorsal positions, especially in the latter, it becomes spread out laterally, and its antero-posterior diameter is diminished. The intestines lie chiefly behind and above the uterus, but, in the dorsal position, they come further down in front over its upper margin. The axis of the uterus is rarely central, and, as in the unimpregnated state, it is more frequently inclined toward the right side. This inclination appears to depend partly upon congenital tendency, partly upon the presence of the rectum and sigmoid flexure toward the left side, and partly upon gravity, since most persons, on account of the weight of the liver, prefer to lie more frequently on the right side. The projection of the vertebral column in the middle line increases the tendency of the pregnant uterus to fall to one side or other in the dorsal position. In addition to the inclination, there is usually also a slight rotation of the uterus towards the right, so that its anterior surface looks not directly forward but somewhat to the right.

Changes in the Cervix Uteri.—It was formerly believed that, during the latter months of pregnancy, the cervix uteri was gradually spread out from above downward, and thus formed the lower segment of the pear-shaped uterine cavity. It is now established that such spreading out is really a part of the process of labour, and that, in the great majority of cases, it does not take place until either a few days before active labour, when it may be effected by painless uterine contractions, or, more frequently, until the commencement of definite labour pains. In very exceptional cases, however, generally those of primiparæ, the cervix may be expanded, so that the bag of membranes rests upon the external os, for some weeks before actual labour. Much more frequently, especially in multiparæ, there is partial dilatation of the internal os in the last month or so of pregnancy, sufficient to let the finger pass through and feel the fœtus presenting, but in these cases the cervix still remains a separate cavity, unoccupied by the bag of membranes.*

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* Recently the old doctrine, somewhat modified, has been revived by Bandl, supported by some other observers, and the subject has given rise to some controversy. Bandl has detected characters of cervical mucous membrane above the limit of the

Softening.—From the commencement of pregnancy, a softening begins in the texture of the cervix, owing to congestion and the

apparent internal os, which closes the cervical canal above toward the end of pregnancy. He believes that in the later months the upper part of the cervical canal becomes enormously dilated, so that the true internal os lies at a point above the symphysis pubis.

There is some difficulty in deciding whether the internal os should be defined as the point where the mucous membrane changes its character, the determination of which is often uncertain in pregnancy, or as that where the strongest ring of sphincter muscle is situated. The latter definition appears preferable, since it is the only one applicable to the infantile uterus, in which the arbor vitæ of the cervical mucous membrane extends some way into the body of the uterus. Adopting this definition, the evidence greatly preponderates that, setting aside the very exceptional cases of primiparæ noted above, the upper limit of the cervical canal in the later months of pregnancy is the true clinical internal os, possessing its powerful ring of sphincter muscle, although it may be true that the characters of cervical mucous membrane may sometimes extend higher up, or that the lower margin of decidua may have lost its characteristic appearance. This appears to be especially demonstrated by the case of placenta prævia. For, if an examination be made at the first onset of hæmorrhage, it may often be observed that the upper orifice of the cervical canal is as yet but slightly dilated, and that the placenta is, in some places, attached to the lower portion of the uterine body up to the very edge of the orifice. Specimens have also been described, notably by Matthews Duncan, Angus Macdonald, and Müller, in which, at the end of pregnancy, the membranes were found attached down to the very edge of the same orifice, at which orifice also the cervical mucous membrane appeared to begin. On the other hand, in a specimen of a uterus of a primipara at the seventh month of pregnancy, described by Marchand, there appears to be a slight expansion of the upper part of the cervix, but the microscopic examination of this part was not satisfactory. (Hart's Atlas of Female Pelvic Anatomy; Plate XXXIV., Fig. 4.) It has been suggested that in primiparæ the upper portion of the cervical canal may become slightly opened up in pregnancy, but that, in multiparæ, this portion has become functionally uterine, and developes a decidual membrane from the first.

The following use of terms should be understood:—Müller's ring is the upper orifice of the cervical canal in the later months of pregnancy. This is probably, at any rate in multiparæ, identical with the true internal os.

By Bandl's ring is meant a line felt, during labour, as a projecting ridge on the internal surface of the uterus, or sometimes through the abdominal wall above the pubes as a line of depression. By Bandl himself and others this is held to be the internal os. By others again it is thought to lie at a higher level than the internal os, and to be the demarcation between the stretched and the thickened segment of the lower part of the uterine body; and, on this view of its nature, it has been termed the *retraction ring*. It is to be noted that the lower segment of the body of the uterus does not necessarily become thinned by stretching. For, although the transverse stretching necessary to allow the passage of the fœtus must tend to make it thinner, the effect of this may be counteracted by the longitudinal shrinking produced by retraction. It is possible, therefore, in some cases at any rate, for the internal os and the retraction ring to coincide, or to be so close together as to be indistinguishable. Experience shows that, if a woman dies during or shortly after labour, the uterus *post mortem* frequently shows no sharp line of demarcation between the thickened and the thinned segment, nor any projecting ridge, but only a gradual transition. It is doubtful whether a definite ridge of constriction inwards can be produced anywhere except by the strongest band of sphincter muscle, unless it merely corresponds to a depression on the surface of the fœtus, as between its head and trunk, or above its arm lying transversely. A ridge due to the latter cause is observable in several frozen sections, and may easily be a source of error. In any case it is very difficult to distinguish it from a ridge caused by a special layer of constricting fibres.

Reference may be made to the following papers:—Duncan, "Researches in Obstetrics," pp. 243—273; Macdonald, Edin. Med. Journ., April, 1877; Bandl, "Ueber das Verhalten des Uterus und Cervix in der Schwängerschaft," Stuttgart, 1876; also effusion of serum in its substance. As early as the end of the first month, a softening of superficial tissue just at the tip of the cervix may be detected. From this part the softening spreads both more deeply into the tissue and upwards towards the uterus. Towards the end of pregnancy the softening is sometimes so extreme, that an inexperienced person may find it difficult to distinguish the cervix from the vagina. By the fourth month the softening is generally sufficiently advanced to be characteristic, although in some cases of multiparæ, where there has been a previous induration of the cervix, the softening is much later in making itself manifest. If, however, a woman is supposed to be in the later months of pregnancy, and the cervix is found to be unsoftened, and projecting into the vagina as in the unimpregnated state, there is a very strong presumption that the supposed pregnancy does not exist, or is not intra-uterine. On the other hand, very marked softening may exist without any pregnancy, as in some exceptional cases of fibroid tumours. The absence of softening is thus of more decisive value as a negative, than its presence as a positive sign.

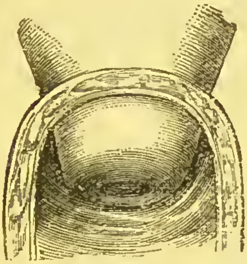

Fig. 67.—Os and cervix uteri at third month of pregnancy (after Tyler Smith).

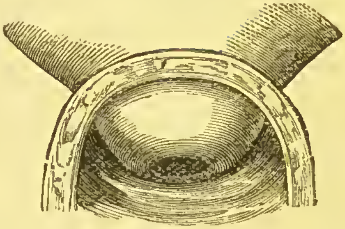

Fig. 68.—Apparent shortening of os and cervix at sixth month of pregnancy (after Tyler Smith).

Apparent Shortening.—Besides this softening, there is an apparent shortening of the cervix, as felt on vaginal examination, and it was upon this shortening that the old theory about the cervical cavity being taken up into that of the uterus was largely based. The apparent shortening as seen and felt from the vagina is shown in Figs. 67, 68. If, however, an opportunity occurs of examining the length of the cervical canal, either after death, or from the external os being patulous enough to allow the finger to be passed into it, it is almost always found that the canal is lengthened rather than shortened, as compared with that of the unimpregnated uterus.

Archiv für Gynäk. XII., p. 334; Küstner, *ibid.* XII., p. 303; Müller, *ibid.* XIII., p. 150, and XIV., p. 181. Sanger, *ibid.*, p. 389; Hart, "Atlas of Female Pelvic Anatomy," pp. 63—77. Barbour, Brit. Med. Journ., 1890, p. 1002, and Atlas, "On the Anatomy of Labour as exhibited in Frozen Sections."

The apparent shortening depends upon two causes. The first is the thickening and extension of the uterine wall, coupled with the ING loosening of the vaginal tissue adjoining, and a traction upwards exercised by the enlarging uterus upon the cervix as it rises higher ON into the abdomen. In consequence of this, the projection of the lip of the cervix into the vagina may become less, without any diminution of its distance from the cavity of the uterus (see Fig. 69). This is especially marked as regards the anterior lip of the cervix, because the prominence of the uterine wall in front, due to its expansion, is generally increased by a bulging outward, due to the pressure of the fœtal head resting in that situation, and thus the angle between the anterior lip and the vaginal wall tends to become effaced. The second cause is the alteration in the direction of the cervical canal. ALTE DIRECT This is generally somewhat flexed forward, even in the unimpregnated uterus. As pregnancy advances, it generally becomes more and more inclined forward in reference to the axis of the uterus, so that the two meet at an angle at the internal os. By this means, the lips of the cervix may become approximated to the uterine cavity, although the length of the cervical canal is actually being increased, as shown in Fig. 69. Towards the end of pregnancy, the cervix uteri becomes more difficult to reach, since it is drawn upward by the uterus rising into the abdomen, and frequently, in addition, is tilted backward toward the sacrum, in consequence of the fundus falling forward through its own weight.

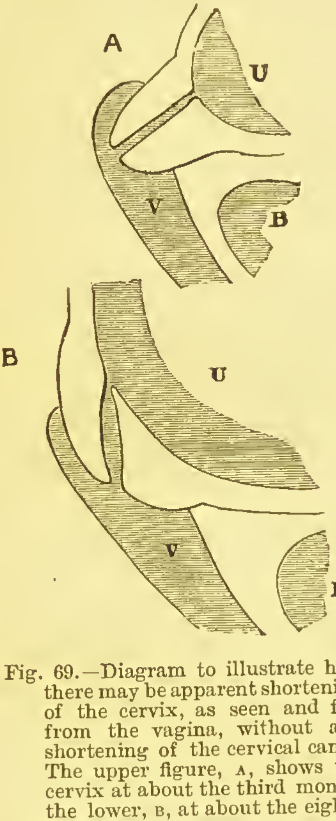

Fig. 69.—Diagram to illustrate how there may be apparent shortening of the cervix, as seen and felt from the vagina, without any shortening of the cervical canal. The upper figure, A, shows the cervix at about the third month, the lower, B, at about the eighth month of pregnancy. U, cavity of uterus; V, vagina; B, bladder.

The cervical glands secrete a thicker mucus than usual during pregnancy, and this usually forms a tenacious white mucous plug, filling up the cervical canal. In parous women, if there is a previously existing eversion of the mucous membrane from laceration of the cervix in a former labour, giving the appearance of a so-called erosion, the hypertrophied papillæ, or villous prominences, become much more enlarged, florid, and soft. The external os generally becomes more patulous than in the unimpregnated state, but this change is more marked in multiparæ, in whom the os is wider to begin with. In first pregnancies the os is generally closed to the finger up to nearly the end of pregnancy. In multiparæ the finger may generally be passed into the cervix in the later months, if not through the internal os.

Changes in Vagina and other adjacent Parts.—The mucous membrane and muscular walls of the vagina become hypertrophied, and its secretion increased. From about the third to the fourth month the anterior vaginal wall feels stretched, from the commencing ascent of the uterus, as well as turgid. In the later months there is so much hypertrophy and relaxation of the mucous membrane that, notwithstanding the lengthening of the vagina, it tends to hang in folds, which appear at the vulva, the prominence covering the urethra being often especially marked. The mucous membrane of the vulva also becomes turgid and relaxed, the secretion of the follicles increased, the veins enlarged, and often varicose, the vaginal outlet wider. The projection of the pelvic floor beyond the outlet of the bony pelvis is, in consequence, notably increased. The round ligaments are much increased in thickness as well as in length, in consequence of the hypertrophy of the muscular fibres contained in them. Owing to the elevation of the fundus they become inclined at a much greater angle to the pelvic brim than in the unimpregnated state. Their action is to draw the fundus downwards and forwards in reference to the axis of the brim. The broad ligaments grow, rather than become unfolded, and the direction of their upper margins becomes very oblique. Owing to the expansion upwards of the fundus uteri, the insertion of the round and ovarian ligaments is no longer nearly at the level of the summit of the uterus, but toward the lower part of its upper third. The Fallopian tubes are increased in length and diameter, and their direction becomes nearly perpendicular to the pelvic brim. The position of the ovaries thus comes to be comparatively low down in reference to the body of the uterus, and near to its walls. The formation of the corpus luteum in the ovary has been already described (p. 43). Further maturation of follicles is almost invariably arrested during pregnancy, but this question will be further discussed under the head of superfœtation. Whether ovulation accompanies or not the menstruation which sometimes occurs during the first few months of pregnancy has not been demonstrated. The whole cellular tissue of the pelvis partakes in the same growth and relaxation as the broad ligaments, and the nutritive changes affect even the pelvic joints, as already described (see p. 10); increased deposit of external fat also takes place about the pelvis and loins.

Mechanical Effects on other Parts.—Mechanical effects arise partly from the direct pressure of the enlarged uterus, partly from the increased intra-abdominal pressure caused by its presence. The degree of the latter depends upon the tightness of the abdominal walls, which is generally much greater in first pregnancies. The capacity of the bladder is diminished, chiefly by direct pressure of the uterus. Hence there is a more frequent need for micturition; and sometimes, in addition, urine is involuntarily expelled, especially in the upright position. Constipation is often troublesome, and is to be ascribed not so much to direct pressure upon the rectum as to general interference with the freedom of peristaltic movement of intestines. Sometimes the pressure on the veins causes œdema of the feet and legs, and in some cases also of the vulva; but this œdema is not often considerable in degree unless there is some additional cause, such as disorder of the kidneys. When there is any tendency to imperfection of venous circulation, the veins of the lower extremities and vulva often become varicose, and this varicosity may become very severe in degree. It is relieved, to a great extent, by a recumbent posture. In the abdominal walls a certain amount of growth and relaxation as well as stretching occurs. The umbilicus, instead of forming a depression, becomes gradually flattened with the surface of the abdomen, and, in the later months, generally forms a soft prominence. In women whose tissues are wanting in tone, the recti are sometimes separated from each other in their middle and upper thirds—a condition which may remain permanent after delivery. In the last three months of pregnancy skin-cracks or *cutaneous striæ* are generally formed from the effect of tension. They are caused by a more or less complete disruption of the deeper connective tissue layer of the skin, and therefore run at right angles to the direction of greatest tension. They are chiefly seen at the sides of the abdomen towards the lower part, running longitudinally, or tending to curve round the umbilicus. They may be formed also upon the breasts, buttocks, and thighs. Although they have been called *lineæ gravidarum* they are not peculiar to pregnancy, but may occur from any kind of distension, even from the rapid growth of fat. They have the appearance of short spindle-shaped lines, generally about half an inch to an inch in length. While the tension lasts, they are reddish or bluish; after delivery they remain as opaque white lines. Sometimes they become the special seat of œdema, or of distension of lymphatics, in consequence of the diminution over their area of the uniform support afforded by the elasticity of the skin.*

Changes in the Breasts.—Almost from the very outset of pregnancy there may be a sense of fulness and tenderness in the breasts, sometimes with darting pains referred to the nipples or glands. These may be regarded as the continuation and development of the similar symptoms sometimes felt by sensitive women before the onset of menstruation. By the second month actual enlargement of the breasts may become noticeable, and it grows gradually more manifest as pregnancy advances. The enlargement is mainly in the glandular tissue itself, though the connective tissue and fat also take part in it. Hence the breast has a knotty feel, due to irregular thickenings in the gland tissue radiating from the nipple. In the later months enlarged blue veins may be seen under the surface of the skin. In an enlargement due to fat there is not the same knotty feel, and the vascular supply is not altered.

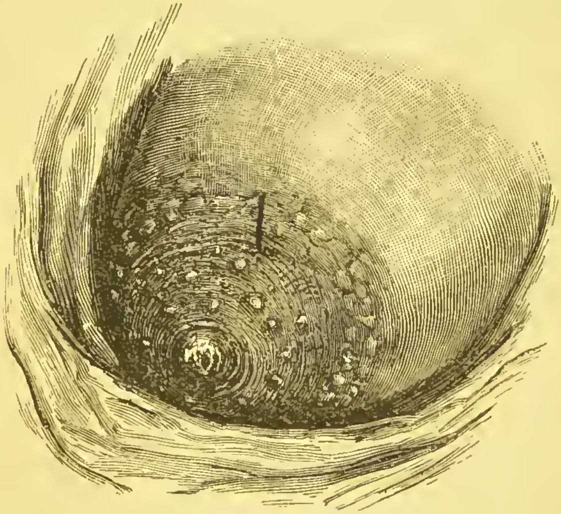

Fig. 70.—Mammary changes in the later months of pregnancy, with formation of secondary areola.

More characteristic signs are found in the nipples and areolæ. The nipples, unless when flattened through pressure by the stays, become more prominent and more susceptible to erection. They are often covered with minute branny scales, due to the drying of the small quantity of secretion which oozes from them. The areolæ become enlarged and darkened by pigment. This change, however, varies very greatly according to the complexion of the woman. In dark brunettes the areolæ may become almost black, in blondes the deposit of pigment may be hardly noticeable. The glandular tubercles of the areola, resembling miniature nipples, ten to twenty in number, become enlarged and prominent, and the whole areola moist, and slightly elevated above the skin. The tubercles may have an excretory duct from which a little milky or mucoid fluid exudes. In the later months there is developed in dark women around the outer part of the areola what was described by Montgomery as the secondary areola. The appearance is that of white spots on a darker ground, and is usually compared to that of colour discharged by a shower of drops of water, falling on a tinted ground. The secondary areola may begin to be visible in some cases as early as the fifth month, and its presence affords a strong presumption of pregnancy (see Fig. 70). Towards the end of pregnancy the breasts droop somewhat, and the nipples become directed downward, so as to be better adapted for the infant to seize.

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* See Busey, "The Cicatrices of Pregnancy;" Trans. Am. Gynæc. Soc., Vol. IV. Duncan, "Phlegmasia Dolens with Lymphatic Varix;" Obst. Trans., Vol. XXIII.

It is possible in many cases as early as the third month to squeeze a drop of secretion from the breasts by dexterously compressing them from the base toward the nipple. As pregnancy advances this becomes increasingly easy. The product formed by the mammary gland at this stage of its evolution is not milk, but a mucoid fluid,* and accordingly the drop so squeezed out is quite clear and transparent. Later on in pregnancy some opaque white material is generally seen, mixed with the clear mucoid fluid. On microscopic examination this is found to consist of the so-called "colostrum corpuscles," similar to those found in the first secretion after delivery. While mucoid fluid may be found in conditions of irritation of uterus or ovaries, or in spurious pregnancy, colostrum is an almost, if not absolutely, certain proof of pregnancy, uterine or extra-uterine.

Diagnostic Value of Mammary Changes.—Changes in the breasts similar to the early stages of those associated with pregnancy not unfrequently occur in connection with various uterine and ovarian disorders, and especially with the so-called "pseudo-cyesis," or imaginary pregnancy, found mostly in women whose menstruation is becoming irregular with the approach of the menopause. Mammary changes also sometimes occur when women have reason to expect pregnancy, as shortly after marriage, or after illicit intercourse. After a previous pregnancy they are of little diagnostic value, for the alteration in the areolæ remains in some degree permanent, and a little secretion may sometimes be still found in the breasts for a long time after lactation has ceased, or even when nothing more than a miscarriage has taken place. In the case of a young woman suspected of pregnancy, the examination of the breasts is of very great though not of decisive value. It has the special advantage that it may often be more readily secured than the opportunity for vaginal examination, and may indicate the necessity for further investigation. Some excuse may be found to look at the breasts, even if we wish to avoid giving any hint of our suspicions to the woman herself. In the absence of very marked changes, the point especially to be sought for is to obtain a drop of secretion, since this sign is independent of varieties of complexion. It is a sign also which often can be found at quite an early stage, before other signs exist, except such as may be overlooked by any but a practised observer. The secondary areola is strong evidence when it is visible, but it does not appear until the stage when positive proof may be obtained by the examination and auscultation of the uterus. In women who become pregnant again while suckling a previous child, the sign of pregnancy is to be found rather in suppression of the milk than in increased mammary activity.

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* See Creighton, "Physiology and Pathology of the Breast," p. 49.

CHANGES IN THE BODY GENERALLY.

Circulation.—As the whole quantity of blood in the body is increased in consequence of the uterine circulation, and as it is not found that the rapidity of the pulse is increased in pregnant women, the cavities of the heart must be dilated so as to propel more blood at each stroke, if the circulation is to be as active as before. This is found actually to take place. With the dilatation is associated hypertrophy, which appears to be not merely compensatory to the dilatation, but to go so far as actually to improve the circulation. Thus women who are subject to chilblains at other times may be exempt from them during pregnancy.

Important changes take place in the quality of the blood. It becomes richer in fibrin and in white corpuscles, poorer in red corpuscles, and also, especially as regards the liquor sanguinis, in albumen. A certain degree of this change is physiological, and dependent upon the activity of the nutritive changes, and the amount of nutriment drawn from the blood by the fœtus and the uterus. The frequent cases in which impoverishment of the blood is more marked must be regarded as deviations from health. They depend for the most part either upon the impairment of digestion which often occurs, or upon a want of that increased supply of nourishing food which pregnancy calls for. The pressure of the blood is increased during pregnancy, and thus, if a sphygmographic tracing is taken of the pulse, the artery will bear a stronger pressure of the spring, and the "tidal" or "predicrotic" wave in the pulse-curve is more marked. Since a similar increase of blood-pressure occurs in chlorosis, in which condition there is also impoverishment of the blood, it is probable that the increased blood-pressure of pregnancy is the cause rather than the consequence of the dilatation and hypertrophy of the heart. It must, therefore, depend upon the altered quality of the blood interfering with the freedom of the circulation, and must be in some degree analogous to the more marked increase of pressure associated with Bright's disease, whether the increase be due, in either case, to the contraction of small arterioles, or to an altered relation between the blood and the capillaries. With the increase of blood-pressure must be associated the slight enlargement of the thyroid gland and the spleen which takes place in pregnancy.

Respiration.—As might be expected, there is an increased discharge of carbonic acid through the lungs in pregnancy—an increase which has been estimated as high as 25 per cent. There is no great difference in the size of the chest, for the space lost by diminution of depth is made up for by increase of breadth at the base of the thorax. Freedom of respiration is, however, interfered with, since the presence of the pregnant uterus limits the descent of the diaphragm in inspiration. Thus there is a tendency to shortness of breath towards the end of pregnancy. Provision is indeed to some extent made by nature for this liability, since it is presumed to be with a reference to the contingency of pregnancy that in women respiration is habitually thoracic rather than abdominal, while in men it is the reverse.

Puerperal Osteophytes.—In nearly half of the whole number of pregnant women calcareous plates are formed after the fifth month on the interior of the skull in the neighbourhood of the vessels between the dura mater and the bone, and these have been called *osteophytes* by Rokitansky. They consist chiefly of carbonate of lime with a large proportion of organic matter. They form irregular plates about $\frac{1}{8}$ inch in average thickness, connected more intimately with the bone than the dura mater. These osteophytes are not peculiar to pregnancy, but are found also in consumptive persons.

Urine.—The quantity of urine is increased, probably in consequence of the increased arterial pressure, since the increase is found to be in the water rather than the solid constituents. The occurrence of albuminuria will be considered among the disorders of pregnancy.

Occasionally a very small quantity of sugar is found in the urine in the later months, not, however, so frequently as in women who are suckling. When it occurs it is attributed to the resorption of sugar from milk secreted in the breasts. A peculiar deposit called *kyestéine*, first described by Nauche, is often found in the urine of pregnant women, if allowed to stand six or seven days protected from dust. A cloud first forms, and afterwards rises to the surface to form a scum which lasts two or three days, and eventually breaks up and falls to the bottom. It is a product of decomposition, and contains triple phosphates, bacteria, and, according to some, an albuminoid substance allied to casein. According to this view its appearance would be analogous to that of sugar in the urine as depending upon the resorption of milk. It is, however, of no value as a sign of pregnancy, since it is not always present in pregnant women, and may be found under other conditions, and in the male sex.

Nervous System.—The irritability of the nervous centres to reflex stimuli becomes increased, probably as part of the physiological process by which they are prepared for the discharge of nervous energy in parturition. By deviations from this normal process arise numerous reflex disturbances. The most frequent of these are disturbances of digestion, especially nausea and vomiting. Craving for food is naturally more frequent, in consequence of the increased demands upon the organism. This is sometimes converted into longings for unusual and even unpleasant articles of food, and thus the unnatural longings of pregnancy have become popularly known. The temper may be changed, so that an amiable woman becomes irritable and peevish, or sometimes, it is said, the opposite change may occur. Other frequent nervous disturbances are hysteria, neuralgia, fainting or dizziness, and perversions of special senses. Eruptions such as acne or eczema probably depend also mainly upon nervous influence. All these changes are departures from a strictly normal condition, and will be further considered among the disorders of pregnancy.

Pigmentation.—There is a tendency to pigmentation in other parts beside the areolæ of the breasts, and in individual instances, chiefly in dark women, this may be strongly marked. Most women show more or less of dark rings under the eyes. The abdomen, axillæ and pubes become darker, and a special dark band is formed along the linea alba from the ensiform cartilage to the pubes. This dark band, however, becomes much more marked after delivery. In rare cases the face is disfigured by irregular patches of pigment.

1. PROBABLE OR SYMPTOMATIC.
2. PHYSICLE OR DIRECT.

CHAPTER IX.

DIAGNOSIS OF PREGNANCY.

It is of obvious importance for every medical man, whatever may be his branch of practice, to acquire skill in the diagnosis of pregnancy, since almost all medical and surgical diseases are liable to be modified by the occurrence of that state. Moreover, not only may it be of extreme importance to the patient to obtain a correct opinion, but the result will inevitably make manifest to all concerned the medical man's skill, or want of skill, in the diagnosis. He will naturally incur ridicule if he is found to have overlooked or mistaken an advanced pregnancy, and may find the result still more unpleasant if he erroneously accuses of pregnancy a virtuous unmarried woman.

The signs of pregnancy may be divided into the probable or symptomatic signs, depending upon the changes induced in the maternal organism, and the physical or direct signs afforded by the growth of the uterus and the ovum. Of these, the former are sufficient only to indicate the probability of pregnancy, while many of the latter furnish the ground for an absolute diagnosis.

SYMPTOMATIC SIGNS OF PREGNANCY.

Suppression of Menstruation.—The cessation of menstruation is commonly the first sign which leads a woman to suspect herself to be pregnant. Its significance as an indication of probable pregnancy is most when the woman appears perfectly healthy, without any anæmia or chlorosis, and when previous menstruation has been regular and not too scanty. A short period of amenorrhœa is not so significant as a longer one. The amenorrhœa is valuable as a corroborative sign when its duration corresponds with the indications given by more direct signs, such as the enlargement of the uterus. Irregular hæmorrhages during pregnancy may be mistaken for menstruation. A more genuine menstruation may occur within the first three months of pregnancy, while there is still a space between the decidua vera and the decidua reflexa.

Cases are even reported to have occurred in which menstruation has occurred throughout the whole of pregnancy, although it is extremely rare for such a thing to occur at regular intervals. In such a case the blood could probably only come from the cervix uteri. If, however, a woman who imagines herself pregnant menstruates regularly, however scantily, there is a strong presumption that the pregnancy is not genuine. It is to be remembered, on the other hand, that suppression of menstruation may occur from various emotional and other causes without marked disturbance of health. Temporary cessation of menstruation sometimes occurs shortly after marriage without any pregnancy, and the same thing may happen after illicit intercourse.

The occurrence of pregnancy during the amenorrhœa of lactation is not uncommon. Pregnancy may also commence in the midst of periods of amenorrhœa arising from other causes, and sometimes even in the case of women who have never menstruated at all. Special care is, therefore, required not to overlook a pregnancy of shorter duration than would correspond to the date of the amenorrhœa. The medical man must also be prepared for possible deception on the part of the woman. Women who wish to conceal pregnancy may deny the suppression of the menses, and may even artificially stain their linen to simulate menstruation. If they confess the amenorrhœa they may give it an incorrect date, generally a more recent one than the true.

Morning Sickness.—Nausea and vomiting are symptoms which often call attention to the probability of pregnancy, especially if they occur without apparent ill-health, or are associated with amenorrhœa, or with obvious enlargement of the abdomen. The nausea or vomiting of pregnancy most frequently occurs when the woman first rises in the morning. Often there is nausea without actual vomiting, or accompanied merely by retching, and perhaps the bringing up of some glairy fluid. These symptoms commonly begin about the beginning of the second month, and are relieved or mitigated at the end of the fourth month. They may, however, commence very soon after conception, and may also continue through the later months of pregnancy. The severer forms of vomiting will be considered among the disorders of pregnancy.

Mammary Changes.—The changes in the breast and their diagnostic value have already been described (pp. 113, 114). In every doubtful or suspected case of pregnancy the breasts should be observed, and it is often convenient to make this the first step in the examination of the patient.

Physical or Direct Signs of Pregnancy.

Enlargement of the Uterus and of the Abdomen.—For examination of the abdomen, the patient should lie on her back on a flat couch, with a small pillow under her head, but not under the shoulders. The thighs should be flexed and somewhat separated, so as to obtain the greatest possible relaxation of the abdominal muscles. The stays, and everything tied round the waist, should be unfastened, and the skirts slipped down so as to uncover the abdomen, keeping the pubes covered. It is generally of advantage to have the skin actually uncovered, to allow ocular inspection of the state of the umbilicus, and of any dark line which may exist, but the palpation and auscultation may be carried out, if necessary, through a thin chemise spread flat over the surface. If the abdominal muscles are rigid, the patient should be directed to look up to the ceiling, letting her head rest easily back upon the pillow, and her attention should be distracted by conversation while the pressure of the hand gradually overcomes the muscular resistance.

By palpation and percussion the position and dimensions of the enlargement formed by the pregnant uterus, if such exists, are made out.

Within the first two months of pregnancy the abdomen may become somewhat flatter than before, from the uterus sinking lower into the pelvis through its increased weight. By the third month there begins to be some enlargement in the lower part of the abdomen. It is generally in the fourth month that it first becomes possible to feel the enlarged uterus in the hypogastric region by external examination only.

The size and position of the uterus in the different months of pregnancy have already been described (p. 106). In the earlier months the consistence of the uterus, except when in a state of contraction, is soft and elastic, so that in this respect it is liable to be mistaken rather for an ovarian cyst or fibro-cystic tumour than for an ordinary fibroid tumour of the uterus. Later on, its consistency becomes quite characteristic, and is sufficient to afford a certain diagnosis of pregnancy. The hand receives the impression of a solid body—the fœtus, floating in liquid—the liquor amnii. Near the end of pregnancy, the actual parts of the fœtus, the head, the back, limbs, and breech may be made out by palpation. Sometimes, when the liquor amnii is abundant, especially about the sixth or seventh month, a fluid thrill may be felt through it, resembling that which may be observed in a simple ovarian cyst.

To estimate the enlargement of the uterus in the early months the bimanual examination is necessary. To gain the full benefit of this, the bladder must be empty, and in a case of any doubt, it is often well to secure this condition by passing a catheter. If a patient is very nervous, and the abdominal muscles very rigid, it may in rare cases be necessary, if it is important to make a diagnosis at once, to administer an anæsthetic in order to obtain a satisfactory result. The patient is still to be in the dorsal position, as for examination of the abdomen. The physician standing at the right side of his patient, passes his right hand beneath the thigh and introduces the index finger, anointed with vaseline or other lubricant, into the vagina, the remaining fingers being bent well back upon the palm. The fingers of the left hand, without any intervening garment, are pressed deeply into the abdomen, not too close to the pubes, and endeavour to get behind the fundus and bring it forward into anteversion, so that the body of the uterus is grasped between the two hands, as shown in Fig. 71. If there is any difficulty about doing this, the finger in the vagina may facilitate the manipulation by first pushing the cervix backwards as far as possible. If the cervix is beginning to ascend, as it does in the course of the third and fourth months, and is therefore difficult to reach, the middle, as well as index finger, may be introduced into the vagina, and an additional reach of about a quarter of an inch thus obtained.

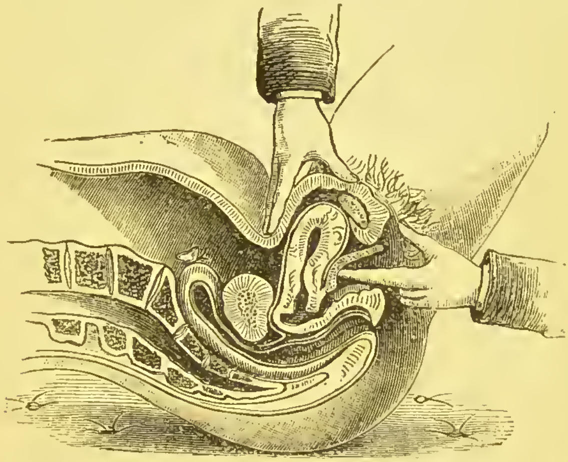

Fig. 71.—Method of bimanual examination of uterus. (After Sims.)

When grasped in this way between the two hands, the uterus in very early pregnancy feels more anteflexed and more anteverted than usual, and the increased breadth of the body and tendency to a globular shape may be made out. On account of its elasticity, the pregnant uterus has the peculiar character that its outline is not so easily defined as that of a uterine enlargement of similar size due to hyperplasia or fibroid tumour. On this account, it may be missed by an unpractised observer, but to a skilled person, this very quality is the most characteristic of pregnancy. If an occasional hardening, due to the intermittent uterine contractions which will be mentioned hereafter, can be detected, the diagnosis is still further confirmed. The uterus, if unimpregnated, can be rolled between the fingers, and the absence of enlargement positively made out. Other kinds of enlargement, due to hyperplasia or tumour, are generally distinguished, not only by their greater hardness, but by being associated, not with amenorrhœa, but frequently with menorrhagia. If the elastic enlargement of the fundus here described can be ascertained, and if it agrees in size with the duration of amenorrhœa, and if in addition, in a nulliparous woman, a little mucoid secretion can be squeezed from the breasts, a practically certain diagnosis of pregnancy may be made even within the first two or three months. The medical man will, however, do well not to commit his credit by an absolutely positive opinion until he obtains the more certain signs of the fœtal heart-sounds, fœtal movements, or ballottement. This method of diagnosing pregnancy by the bimanual examination of the uterus depends greatly upon the *tactus eruditus* gained by practice, and it frequently happens that the inexperienced overlook a pregnancy of as much as three months' standing, or even longer. The student should therefore lose no opportunity of becoming familiar with the feel of the fundus uteri in the early stage of pregnancy. The only condition in which this method of examination fails to afford a good result, is when the fundus uteri is partially retroverted or retroflexed, so that it is impossible to get the fingers of the external hand sufficiently behind the uterus to bring it forward into a position of anteversion. Even then, the administration of an anæsthetic would generally overcome the difficulty.

Changes in the Cervix Uteri and Vagina.—The diagnostic value of the changes in the cervix and vagina has already been described (pp. 107—111). It is especially important to ascertain whether the degree of change discovered corresponds to the date of pregnancy as estimated by the size of the uterus, determined by bimanual or abdominal examination. Towards the end of pregnancy in multiparæ, the finger may often be passed through the cervix into the uterus, and feel the membranes and presenting part of the fœtus. In order to carry out the manipulation, for which a long finger is an advantage, the woman is placed in the dorsal position, and the bladder emptied. The finger is then passed into the cervical canal, and the cervix drawn slightly forward by its means, the external hand at the same time pressing the fundus backward, until the tip of the finger can be passed through the internal os, if sufficiently patulous. If there is a difficulty in reaching the cervix sufficiently to observe its softening and apparent shortening after the third or fourth month of pregnancy, when it rises to a greater distance from the vulva, it is a good plan to make the patient turn on to her left side, if the examination is being made with the right hand. It is then possible to retract the perineum more thoroughly, and thus to reach to a higher level in the hollow of the sacrum.

Violet Coloration of Cervix and Vagina.—Besides the changes in the cervix itself, strongly pulsating arteries may often be felt in its neighbourhood through the vault of the vagina in early pregnancy. These, however, may be found also in the case of periuterine inflammation, as well as in that of tumours, especially fibroid tumours of the uterus. A sign of more importance is to be found in the violet coloration of the cervix uteri, vagina, and vulva. The colour differs from that produced by active congestion or inflammation of the mucous membrane by its bluer tint, due to its being the effect of venous obstruction, the result of pressure. The blue tint is first to be recognised in the cervix itself, and hence it is sometimes an assistance to diagnosis, within the first three months of pregnancy, to examine the cervix with a Ferguson's speculum. A similar appearance, however, may result from the pressure of a tumour.

Intermittent Uterine Contractions.—Throughout pregnancy, gentle painless contractions of the uterus take place at intervals, by discharge of centric nervous force, and similar contractions may often be excited by manipulation of the uterus. That they do not however solely depend upon external stimulus, is proved by the fact that the uterus may sometimes be found tense when the hand is first laid upon it. The tense condition generally lasts for a minute or two, resembling in its duration a labour pain. It may be possible to detect the alternate contraction and relaxation of the uterus as soon as it comes into contact with the abdominal wall, and it becomes more and more easy to do so as pregnancy advances. It may often however be necessary to watch the case for some time, and make repeated examinations, before a decisive result is obtained. In the intervals of relaxation, the uterus lies flaccid under the action of gravity, its outline is indistinct, and the fœtus, if large, can be easily felt through its walls. During a contraction it resumes more or less its true pyriform shape, so that it becomes more prominent in front, its boundaries become definite, and the tenseness of its surface prevents the parts of the fœtus from being distinctly felt. If this sign is obtained in a strongly marked degree, it is proved not only that pregnancy of some sort exists, but that it is intra-uterine. In the case of a soft fibroid tumour, variations of density may take place owing to uterine contractions, but these are never so strongly marked as the more characteristic changes which may be observed in a pregnant uterus. Similar changes might conceivably occur in a distended bladder, but have not been observed in it, and it seems that the bladder, when over distended, loses its contractile power. The pregnant uterus, when in an irritable state, sometimes remains continuously in a partially contracted and tense condition, and it may then be impossible to detect alterations of tenseness in its walls. The failure, therefore, after repeated attempts, to detect contractions, does not prove that any given swelling is not the uterus, although, if the presumed pregnancy is at an advanced stage, it should always excite suspicion on this point.

There are two cases in which this sign is of special value. The first is when an irregular tumour exists, and there is doubt whether a part or the whole of it is formed by the pregnant uterus. If the hardening of contraction extends over the whole mass, it is proved that the whole of it, however irregular, consists of the uterus. The second case is that of an excess of liquor amnii, when the fœtus is too small to give signs of its life, and the pregnant uterus may be mistaken for an ovarian cyst, and is liable even to be tapped under such a mistaken diagnosis.

Ballottement.—By ballottement (*ballotter*, to toss up like a ball,) is meant the sensation imparted to the fingers when they are placed beneath the fœtus, and, as it were, toss it up in the liquor amnii. There are two kinds of ballottement, internal and external, of which the internal is by far the most valuable as a sign of pregnancy. Internal ballottement is obtained in the following manner: The woman is placed in the dorsal position, the index finger, or two fingers, of one hand are introduced into the vagina, while the fundus is pressed down by the other hand or by an assistant. The uterus is brought into the most favourable position if the woman takes a deep breath, and then holds her breath for a moment. The finger in the vagina, with its tip resting just in front of the cervix, then gives a sudden but gentle push or jerk upwards. The hard fœtal head, which is frequently resting at this spot, is felt to recede from the finger, and, after a moment's interval, to return with a gentle tap. This constitutes the complete sign of ballottement, but sufficiently characteristic evidence may often be obtained even if a distinct return-tap cannot be made out, provided that the hard body can be felt to recede, and, after a moment or two, to have returned to its former position. If the fœtal head does not rest in front of the cervix when the woman is horizontal, it may often be made to do so, and to give the sign of ballottement, if she is placed in a reclining position, with the shoulders and head raised but supported by pillows, so that the axis of the uterus is nearly vertical, or its upper extremity inclined somewhat forward. If this also fails, the finger may be introduced into the vagina as the woman stands upright. If any other part than the head is presenting, internal ballottement cannot so easily be obtained. Ballottement is chiefly available from the end of the fourth to the seventh month, and is most marked about the middle of that period. It may sometimes be obtained in the latter half of the fourth month, earlier than it is possible to detect the fœtal heart-sounds, and it is at this early stage that this sign is most valuable. In the last two months of pregnancy, the quantity of liquor amnii becomes relatively too small to allow the fœtus to be tossed up, but the hard fœtal head, if presenting, may be felt through the uterine wall by the finger placed in front of the cervix, and may be moved by it to some extent.

Internal ballottement is a positive sign of pregnancy, though not of the life of the fœtus, if detected by a skilled observer. An inexperienced person might possibly mistake an anteflexed fundus uteri, especially if associated with ascites, for the fœtal head; but the anteflexed fundus would not give the distinct return-tap upon the finger after tossing up which makes the sign of ballottement complete. A calculus in the bladder is generally mentioned as giving a sensation similar to ballottement. This would almost certainly be associated with symptoms referable to the bladder and would easily be distinguished by passing the bladder sound; moreover, there would probably be no enlargement of the fundus uteri.

External ballottement is obtained in the following manner: The woman is placed in the lateral or semi-prone position, so that the uterus rests against the couch, or overhangs its edge. One hand is placed above the uterus to steady it, while the fingers of the other are laid flat beneath the uterus at any point where a firm portion of the fœtus can be felt, and give it a jerk upwards, as in the case of internal ballottement. This sign is comparatively valueless in diagnosis; for the uterus and the fœtus do not come sufficiently into contact with the abdominal wall to allow it to be obtained until pregnancy is so far advanced that other and better evidence may be secured.

Fœtal Movements.—Fœtal movements probably commence at a very early stage in the development of the muscular system of the embryo. They are generally first felt by the mother about the end of the fourth month, but the time when this occurs is very variable. The first feeling of the fœtal movements, which is known by the name of *quickening*, is supposed to depend upon the uterus having risen sufficiently into the abdomen to come into contact with the abdominal walls. The unaccustomed sensation, when first felt, especially in first pregnancies, often gives rise to a feeling of faintness, or other disagreeable nervous symptoms. As pregnancy advances, the motions become more and more manifest; in the later months they may often be seen as well as felt, and can readily be excited by stimulating the fœtus with pressure through the abdominal wall. Fœtal movements may be heard on auscultation before they are recognised by the mother, and before the fœtal heart is audible. The sound at first is a faint thud, later in pregnancy louder thuds or taps may be heard, and sometimes loud scratching or rubbing noises, as the fœtal extremities scrape against the interior of the uterus. When pregnancy is somewhat advanced, an impulse against the stethoscope may often be felt accompanying the sound. The movements may sometimes be felt from the abdomen by the physician before the mother feels them, and at an earlier stage still, before the uterus has come into contact with the abdomen, they may sometimes be felt from the vagina, or on bimanual examination. Movements may be felt in this way from the vagina as early as the beginning of the fourth month, and may be heard on auscultating the abdomen about the middle of the fourth month.

Recognition of fœtal movements is of great value in diagnosis, for it proves not only pregnancy, but the presence of a living fœtus, and often it does this when the fœtal heart cannot be heard. The subjective sign of quickening is of little or no value, for sometimes women fail to perceive the movements up to quite a late period of pregnancy. More frequently, even women who have borne several children mistake intestinal movements for those of a fœtus, and on this ground become firmly convinced that they are pregnant. Even the physician will find a faint sound of fœtal movement more difficult to be certain about than the sound of the fœtal heart, and must take care not to mistake for it either movements of the abdominal muscles or those of the intestines. The sign is greatly confirmed if the movements can be felt as well as heard. There is one case in which the recognition of fœtal movements by feeling from the vagina is of special value. This is when pregnancy is complicated by an abdominal tumour, which may prevent the fundus uteri from coming into contact with the abdominal walls up to a much later period than usual, so that the usual signs, on auscultating the abdomen, are entirely absent, and even the enlargement of the fundus uteri may be obscured by the presence of the tumour.

Uterine Souffle.—The uterine souffle is a soft blowing murmur, synchronous with the maternal pulse. It is generally heard on one or both sides of the uterus, rather low down, but sometimes it is audible over a considerable part of the fundus. It was formerly called the placental souffle, from the belief that it had its origin in the placenta. This is disproved by the fact that it may be heard for some days after delivery, with diminishing intensity, and that a similar souffle may be heard in some cases of uterine tumour. It is now generally agreed that the uterine souffle has its origin in the ORIG large arterial branches approaching the uterus from the broad ligaments and entering the uterine walls. ART No certain inference can be derived from it as to the position of the placenta. The arteries however are most developed in the neighbourhood of the placenta, and if the souffle is heard widely over the fundus in front, there is a certain presumption in favour of the placenta being attached in front. The converse inference must not be drawn from the absence of a souffle in front. The souffle is physically explained, partly by the presence of many large arterial branches having tortuous courses, and partly by the deteriorated quality of the blood in pregnancy, which renders it more prone to generate a murmur, as in the case of the arterial and venous murmurs of anæmia. The souffle is loudest when the blood deterioration is greater than usual. In some such cases the murmur can be distinguished as being double, the second and fainter element corresponding to the dicrotic wave of the pulse. The uterine souffle differs slightly from the murmur produced by pressure on a large artery in that it swells and dies away more gradually, and is generally softer. This probably is due to its being produced in a number of arterial branches of various sizes. It has been compared to the puffing of the engine of a goods-train going slowly, and heard from a distance. The uterine souffle of pregnancy has also the special character that it is very variable at different times in the same person. This character appears to depend mainly upon the effect of contractions of the uterus, and partly also upon changes in its position. As a uterine contraction comes on, the souffle becomes raised in pitch, and thereby often for a time louder, sometimes even almost whistling in tone. As the contraction reaches its height, it becomes fainter, and may be even suppressed, resuming its original quality as the pain passes off. The souffle may sometimes be modified to some extent by pressure with the stethoscope.

The uterine souffle may be heard towards the end of the fourth month, and therefore generally earlier than the fœtal heart-sounds, some say even as early as the eighth or ninth week. In the early months it must be sought for by placing the stethoscope close above the pubes at either side, and pressing it deep down to reach the sides of the uterus. The souffle is of considerable value in the diagnosis of pregnancy, especially in the earlier months, when the fœtal heart cannot be detected. It is true that it may be heard in uterine tumours, but these are rarely associated with amenorrhœa. Moreover, a tumour equal in size to a uterus pregnant less than four and a half months rarely gives a souffle. If the souffle is found to have marked variations of quality and loudness, the presumption of pregnancy is increased, for tumours are not subject to such marked contraction as the pregnant uterus. A souffle may be heard in extra-uterine pregnancy, but not so constantly as in normal pregnancy; and, if heard, it would not be so likely to vary in quality.

Fœtal Heart-Sounds.—The fœtal heart-sound is double, like that of a heart in after-life, but the distinction in quality between the two sounds is not so marked. When the heart is heard only faintly, the first sound alone may be audible. The quality of the sound has been compared to that of a watch (not a lever watch) ticking underneath a pillow. The student can however best learn it by listening to the heart of an infant soon after birth. The rate generally varies between 120 and 160 in the minute. It has often been stated that the rate is most rapid when the heart-sounds first begin to be heard, while the fœtus is still very small, and that it diminishes in rapidity with the advance of pregnancy. In reality, however, there is no marked progressive change. The rapidity of the heart is much increased, sometimes as much as twenty beats in the minute, by active fœtal movements. It varies also to some extent in accordance with the condition of the mother. When the maternal pulse is rapid on account of fever, the rate of the fœtal heart may be increased also, although not in anything like the same proportion. As in the case of the adult heart, an elevation of the blood-pressure makes the heart's rapidity less. In the case of the fœtus, the blood-pressure is chiefly liable to be affected by pressure upon the funis and placenta. Thus, during a labour pain, the fœtal heart becomes slower, and resumes its former rapidity when the pain is over. During a head-last delivery, when the funis is pressed upon, the fœtal pulse-rate, as observed in the funis, may become very slow, and a sudden and great increase of rapidity may then sometimes be noticed the instant the head is liberated. The fœtal heart-rate also becomes slower as the vitality of the fœtus is becoming exhausted by prolonged pressure in delivery; and thus, in protracted labour, as the mother's pulse becomes gradually more rapid, the fœtal heart becomes gradually slower. This change of rapidity affords a valuable sign of danger to the child's life. In this case the heart only gradually returns, after delivery, to its former rapidity or nearly so. The fœtal heart-sounds can generally be detected for the first time in the course of the fifth month of pregnancy, generally from the eighteenth to the twentieth week. Under unusually favourable circumstances, they may be heard as early as the fifteenth or sixteenth week, and they become progressively louder as pregnancy advances.

The fœtal heart-sounds are by far the most valuable of all the signs of pregnancy. If they are recognised, it is proved that pregnancy exists with a living fœtus, and the only possible further doubt that could arise is whether the pregnancy is normal or extra-uterine. If then the presumed pregnancy has reached the fifth month, it is well to make the listening for the fœtal-heart one of the early steps of the examination. If it is detected, only a confirmation of the pregnancy being intra-uterine is required, and this is to be found in the changes of the cervix, the characters of the uterine tumour, and its alternate contraction and relaxation. To listen for the fœtal heart, perfect quiet in the room must be secured, and any ticking clock should be stopped. The stethoscope should be pressed gently upon the abdomen by resting the ear upon it, and should not be held by the fingers, or allowed to touch the clothes. Some prefer a binaural stethoscope, as intensifying sound, but I have often found it fail to reveal the fœtal heart when an ordinary cedar stethoscope succeeds, probably because muscular sounds are more liable to create confusion in the binaural. The fœtal heart should always be counted, and it should be noted whether the rate remains tolerably constant in successive quarters of a minute. If it cannot be counted, the sign must be regarded as uncertain.

The heart-sounds are transmitted best through the back of the fœtus when the fœtus is in its usual attitude. Toward the latter part of pregnancy, therefore, if the fœtus is lying in the first position, with its back towards the left side, as it is in the great majority of cases (see Fig. 57, p. 95), the likeliest place to hear the fœtal heart is about half way between the umbilicus and the centre of Poupart's ligament on the left side. If it is lying in the second position, with its back toward the right side, the heart is heard best in the corresponding position on the right side. Earlier in pregnancy, the stethoscope must be placed lower down towards the pubes. When the fœtus is presenting by the breech, the fœtal heart is heard relatively higher up, in proportion to the size of the uterus. In face presentations, it is heard through the thorax better than through the back. In any other than a face presentation, when the back of the fœtus is lying backward, and the limbs with a good deal of liquor amnii intervene between its trunk and the surface of the uterus, the fœtal heart is heard less distinctly, and sometimes not heard at all. If, therefore, it is not heard at the first attempt, repeated trials should be made on different occasions, and it must not be assumed that the child is necessarily dead, if the fœtal heart appears for a time to have disappeared. In order to catch the fœtal heart-sounds at an early stage of pregnancy, a great deal depends upon the observer's ear being practised in distinguishing them. It is therefore desirable even for those who are skilled in auscultation in general, to take opportunities of practising this form of it in particular. When the sounds are faint, they are only heard over a very limited area. If, therefore, they are not at first detected, the attempt should not be given up until the whole surface of the uterus has been explored. In the case of breech presentation, the best position for hearing the sounds may be above the umbilicus.

The chief fallacy which is likely to occur is the mistaking the woman's heart-sounds, which may sometimes be heard in a similar situation, especially when a tumour is present, for those of a fœtus. If the mother's pulse is slow, while the fœtal heart has its usual rapidity, counting the two is sufficient to distinguish between them. If, however, the woman's pulse is rapid, 120 or more, great care is required. The radial artery should be felt while the ear rests upon the stethoscope. If the sounds heard are really those of a fœtal heart, it will be found that the two will not continue exactly synchronous for long together, even though their rates are about the same, but one or the other will fall behind. Another test, which should be used in addition in any case of doubt, is to trace the sounds towards the woman's heart. Fœtal heart-sounds will then be lost, but the woman's heart-sounds will become gradually intensified.

Variation of rate of heart according to sex and size of fœtus.—It has been found that the average rate of heart is more rapid in girls than in boys. The average for all children is about 132 per minute. If the rate much exceeds this, say amounts to 140 or more, there is a certain presumption in favour of the child being a girl; if it falls much below it, say is only 124 or less, in favour of its being a boy. The observation is only of value if made before labour has begun, in the last two months of pregnancy, and while the fœtus is quiet. The rapidity of the heart, however, varies considerably in the same children at different times without any obvious cause, and hence the method is extremely uncertain. Predictions in individual cases would not come true in more than two cases out of three at the most. There have been also observations tending to show that the rate of the heart is slower, the larger the child; and it has been inferred by some that boys have slower pulse-rates only because they are generally larger than girls. The

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fact that there is no marked change in the heart's rapidity from the time when it is first heard, when the fœtus is quite small, would seem to be rather against this view. At the sixteenth week I have found the rapidity to be not greater than 140 per minute.

Funic Souffle.—Occasionally, instead of the double fœtal heart-sound, a blowing murmur is heard. Sometimes this replaces the fœtal heart-sounds altogether, but more frequently the clear heart-sounds are heard at one spot, the murmur at another. Such a murmur is rarely a cardiac bruit, and is generally produced in the funis, at some point where it is subjected to pressure or twisted. It is very variable in the same persons. According to some, it may be heard in as many as 12 or even 15 per cent. of cases at the end of pregnancy. It is of no practical value in diagnosis, unless when it replaces the fœtal heart-sounds.

Special forms of stethoscope have been made to auscultate the uterus through the vagina; and by means of these, the fœtal movements, the uterine souffle, and possibly the fœtal heart-sounds, may be heard somewhat earlier. These are not likely, however, to come into general use.

Recapitulation of signs in order of date.—A brief recapitulation of the more important signs of pregnancy in the order of their occurrence may here be of use. (1)Suppression of menses generally dates from the commencement. (2)Pain, tenderness, and slight swelling of the breasts, may begin from the very first. 3 Morning sickness may also begin from the first, but more commonly in the second month. Within a very few weeks, the time varying according to the skill of the observer, 4 elastic enlargement of the fundus uteri may be made out bimanually. From the beginning of the second month (in primiparæ) 5 softening begins at the tip of the cervix, and gradually increases. In the second or third month some 6 violet coloration of the cervix, as seen by speculum, may commence. 7 By the beginning of the third month some mucoid secretion may be squeezed from the breasts. 8 In the third month fœtal movements may possibly be felt from the vagina or bimanually. From the beginning or middle of the fourth month they may be heard from the abdomen; and from the end of the fourth month they may also be felt externally. 9 In the fourth month the changes of softening and apparent shortening in the cervix are generally characteristic, and the cervix begins to ascend higher. Sometimes, by the middle of the fourth month, or, at any rate, at the end of it, 8 ballottement may be obtained. Towards the end of the fourth month, and sometimes even earlier, the 9 uterine souffle may be heard. 10 Alternate contractions and relaxations of the uterus may be made out generally during the fifth month. The fœtal heart is generally first heard during the fifth month, from the eighteenth to the twentieth week, but sometimes before the end of the fourth month. In the fifth month also, the "secondary areola sometimes begins to be visible round the nipples. From this time onward all the signs become progressively more manifest, except ballottement, which fails in the last two or three months. 12 In the last two months, in multiparæ, the finger may sometimes be passed through the cervix, and feel the presenting part.

Differential diagnosis of pregnancy.—A diagnosis of pregnancy must be based on the recognition of the physical or direct signs of that state, and it is therefore unnecessary to go through all the conditions which might possibly be mistaken for pregnancy, since in all of them these direct signs will be absent. In a case of doubt the order of investigation should be to ascertain, first, that some tumour is present in the abdomen; secondly, that it is the enlarged uterus; and thirdly, that the enlargement is due to pregnancy. It is chiefly within the first four months, and especially the first three months, that some uncertainty may exist, but a month or two's delay will then always solve the question. Within the first four months, the enlargement of the uterus due to pregnancy has to be distinguished from that due to fibroid tumour or chronic hyperplasia, and the distinction may generally be made by the peculiar elasticity, and indefinite outline, of the pregnant uterus. It is to be remembered, however, that a dead ovum may be retained for months within the uterus, and that the uterus in such a case may become hard. The nature of the case will then generally be indicated by the history, especially by the absence of menstruation, but sometimes can only be cleared up by exploration of the cavity of the uterus. (See Chapter XXII.) The tumour formed by *hæmatometra*, or distension of the uterus with retained menstrual secretion, may resemble the pregnant uterus, though generally it is more tense. In this case, there will be a history of spasmodic pain recurring every month; and either the patient will be a girl who has never menstruated externally, or there will have been some cause, such as an operation on the cervix, to produce occlusion of that canal. Moreover, the impervious state of the vagina or cervix may be detected on examination. The most difficult cases for diagnosis are those in which pregnancy is complicated with a uterine or ovarian tumour. In these the tumour may obscure some of the usual positive signs; and not only has the fact of pregnancy to be made out, but they have to be distinguished from cases of extra-uterine pregnancy, which also generally produces an irregular mass in the abdomen. In these cases the utmost pains must be taken to ascertain how much of the tumour consists of the uterus, and whether there is a fœtus inside or outside the uterine cavity. The diagnosis of pregnancy with excess of liquor amnii from an ovarian cyst, often a difficult one to make, will be considered under the head of hydrops amnii.

Pseudocyesis, or spurious pregnancy.—A case in which a diagnosis is often called for, but in which it is not difficult to make, if any care is used, is that of imaginary or spurious pregnancy, to which the term *pseudocyesis* has been applied. In this condition many of the more superficial signs of pregnancy may exist, suppression of menstruation, mammary changes with presence of secretion, prominence of abdomen, and supposed fœtal movements. It may occur at any time of life in women who desire or expect that they may become pregnant. It is most frequent, however, at the approach of the menopause, when menstruation is arrested, or perhaps has only become very scanty, and there is at the same time a deposit of fat in the abdominal walls and flatulent distension of the intestines. The prominence of the abdomen may be due simply to these causes, but often it is produced also in part by the attitude assumed, the convexity forwards of the lumbar spine being increased, and the shoulders thrown back. The mental condition has much to do with the production of this state, which is more frequently found in hysterical women. It may vary from a not unnatural mistake, dispelled at once by a medical opinion, through all degrees up to an almost insane delusion, proof against assurances, which may persist for more than the natural nine months of pregnancy. In more rare cases, in addition to the spurious pregnancy, there is a spurious labour when the expected time of delivery has arrived, and labour pains seem to come on, and recur for some time at regular intervals. This generally happens to a woman whose medical attendant has accepted her own account of her condition without investigation.

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Spurious pregnancy is easily recognised on examination. There is no complete dulness in the abdomen, though there may be diminished resonance from deposit of fat. The os is found unaltered, and there is no uterine tumour to be felt on bimanual examination. The apparent tumour produced by arching of the spine and tension of the muscles is, if necessary, dispelled at once on the administration of an anæsthetic. The formality of this proceeding, coupled with a consultation, is often of great use in convincing the patient, or at any rate her friends, that no pregnancy exists.

Diagnosis of the life or death of the fœtus.—The indications of the life of the fœtus to be relied on are the fœtal heart-sounds and fœtal movements. If, after being manifest, these can no longer be discovered on repeated examinations by a competent person, its death may be inferred. Some weight, but not an absolute one, may be attached to the sensation of movements by the mother. In the earlier months of pregnancy, before movements or heart sounds are distinguishable, the fœtus may be inferred to be dead if the enlargement of the uterus be observed to have become arrested, and there has been a recession in the development of the breasts. Sometimes, but not always, the mother's health becomes impaired in such a case. In some cases, especially when at least the half term of pregnancy has been reached, the death of the fœtus produces an increased secretion of colostrum or milk, similar to that which occurs after its expulsion. This is shortly followed by recession of the breasts. Generally, after death of the ovum, reflex symptoms of pregnancy, such as vomiting, diminish or disappear. But, in some instances, vomiting and general malaise commence only on the death of the ovum. A sense of coldness in the situation of the uterus is given as a sign of death of the ovum, but is not much to be relied upon. The dead ovum cannot of course become colder than the maternal tissues surrounding it, although it ceases to impart warmth to them. Considerable and persistent hæmorrhage from the uterus does not necessarily imply the death of the fœtus, an offensive uterine discharge generally does so. If the finger can be passed through the os, and feel the cranial bones loosened in the scalp, the death of the fœtus is assured.

Diagnosis between first and subsequent pregnancies.—The most valuable distinction between first and subsequent pregnancies is to be found in the condition of the hymen. The effect of coitus is generally to tear notches in the edge of the hymen. These do not, however, extend completely down to the base of attachment of the hymen, which forms the lower limit of the vagina. In a nulliparous woman, therefore, the hymen can always be easily traced, its attachment being continuous, its free border more or less broken up. If the two index fingers be inserted between the hymen and the fourchette, and separated a little laterally, the fossa navicularis, or boat-shaped depression thus produced, can be made out. On the other hand, the effect of parturition in a primipara, either at full term, or in the later months of pregnancy, is to produce an inevitable laceration of the vaginal outlet, formed by the hymenæal attachment, this being the narrowest and least dilatable part of the canal formed by the soft parts. The laceration consists of one, or more frequently several, longitudinal rents, extending completely to the base of the hymenæal attachment and separating the component parts of the hymen. In a parous * woman, therefore, the hymen either remains only in the form of several detached prominences of mucous membrane, the *carunculæ myrtiformes*, or at any rate, there are one or more well-marked spaces, or cicatricial bands separating its torn fragments. The fossa navicularis no longer exists as a depression ; but the mucous membrane forming it has become flush with the posterior vaginal wall. The essential part of the process concerned in the production of carunculæ myrtiformes is the sloughing of intermediate portions of hymen, which only occurs after the bruising of labour. The only thing which could possibly simulate the effects of labour is the delivery of a large tumour through the vagina.

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* *I.e.* woman who has borne one or more children.

There are many other signs whose presence affords more or less positive evidence of a previous pregnancy, though their absence does not prove that a former parturition may not have occurred, especially at an interval of a considerable number of years, or before the full term of pregnancy. The most decisive of these are the existence of old lacerations of the perineum, either destroying the fourchette only or extending more deeply, and alterations in the cervix. Generally, in parous women the os uteri is converted from a round or oval opening into a transverse slit, from slight notches at each side having been produced by laceration in parturition ; and from the same cause the cervix becomes broader at the end and less tapering. It also softens less early in a subsequent pregnancy. Not unfrequently there is more obvious evidence of previous parturition in the presence of the deeper lacerations not uncommonly produced in labour. These are most frequently bilateral, usually deepest on the left side, and they are often accompanied by eversion of the anterior and posterior lips of the cervix. Sometimes they are unilateral, triradiate, or still more irregular. Other signs are the result of distension in previous pregnancies. The abdominal walls, instead of being tense, are often lax, so that they can be raised in a fold between the fingers, and allow the uterus and parts of the fœtus to be more readily explored. The breasts are flaccid and drooping instead of being firm and tense. Besides the reddish or bluish skin-cracks on the side of the abdomen and the breasts which appear only in the latter months of pregnancy under the influence of actual tension, other old, silvery white, skin-cracks (*lineæ albicantes*) may be detected, before the skin is actually put on the stretch.

CHAPTER X.

THE DURATION AND HYGIENE OF PREGNANCY.

The duration of pregnancy.—It is never possible, in the human subject, to determine the exact date of conception. It is only in very exceptional cases that the date of fruitful coitus is known, and even when this is the case, it is possible that conception may not occur for several days, possibly even as much as ten or fourteen days afterwards, the spermatozoa meanwhile retaining their vitality. In general, the only date we have to reckon from is that of the last menstruation. In the case of domestic animals, where there is generally only a single coitus, and that at a period of ovulation, more exact observations are possible. The result is to show that there are considerable variations in the duration of pregnancy dating from the coitus, greater even than are supposed to occur in the case of women. Not only do some deliveries occur considerably before the average date at which the great majority take place, a result which might be due to premature labour, but a few occur considerably after it, and thus appear to prove an unusual protraction of gestation in some individual cases. Thus in cows the average duration of pregnancy is about 282 days. Out of 140 cows observed by Tessier, 121 calved between the 269th and 290th day, but 5 calved between the 290th and 308th day. Again in mares, the average duration is about 348 days. Out of 102 mares observed by Lord Spencer, 72 foaled between the 340th and 360th day, but 21 foaled at various times from the 360th to the 377th day, and one on the 394th day. From analogy it may be expected, that, in the human subject also, pregnancy may in exceptional cases be protracted longer than usual, and the child probably in consequence attain an unusual size.

The calculation of the average duration of pregnancy from a single coitus is open to considerable uncertainty, since many of the cases are those of unmarried women whose statements on the subject are open to suspicion. Matthews Duncan has collected 46 cases, and calculates an average of 275 days. Other authors give other estimates, generally lower than this, and varying from 271 to 276 days.* The question of the duration of pregnancy from the fertile coitus is chiefly of interest in reference to the medico-legal question, whether a child is to be regarded as possibly legitimate or not, when born at an interval longer than usual after the last possible date of coitus with the husband. The laws of Scotland, France, and Austria, allow a possible limit of 300 days, that of Prussia one of 302 days. In England and America no absolute limit is laid down, but each case must be judged on its merits. In America, a very liberal view has been taken, and legitimacy has been allowed after intervals of 313 and 317 days. No cases of protraction beyond 300 days from a single known coitus has however, been scientifically established. Of James Reid's cases the longest was 293, and Leishman relates a case of a married lady, in which the interval was 295 days, and the child weighed 12lb. 3 oz. Of cases in which the minimum duration of pregnancy was supposed to be fixed by the death or departure of the husband, one recorded by Mr. Hewitt gives 308 days, one by Sir James Simpson 313 days, and two by Dr. Murphy 314 and 324 days respectively. The two last, at least, are reasonably open to doubt, but there is some reason to think that pregnancy may possibly be sometimes prolonged to the equivalent of ten menstrual periods instead of nine, or to about 308 days. For cases have been recorded in which labour pains have come on at the expected time, but have passed off again and have not recurred until four weeks later, while the child, when born, has been of unusual size and weight. In any medico-legal case, the fact of a child having been of unusual size at birth would be evidence in favour of the possibility of the pregnancy having been unusually protracted, although it is also possible that the child might be unusually small at full term, and therefore not larger than usual when born at a later period.

Cases are recorded of very considerable apparent protraction of pregnancy from the date of the last menstrual period. It is not wonderful that this should be the case, since it is an undoubted fact that conception may occur during a period of amenorrhœa, and such cases prove nothing as to real prolongation of gestation. It is possible that cases of apparent protraction for two or three weeks may depend upon conception having occurred just before the first menstrual period which failed to appear. The following table gives the result of 650 cases in which the fœtus was apparently mature, observed by Merriman and James Reid, the duration being calculated from the last day of menstruation.

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* See Montgomery, "Signs of Pregnancy," 2nd ed., p. 493, *et seq.*; Duncan, "Fecundity, Fertility, and Sterility," 1871, p. 457; Ahlfeld, "Beobachtungen über die Dauer der Schwangerschaft;" Mon. f. Geb. XXXIV., 1869; Löwenhardt, "Die Berechnung und die Dauer der Schwangerschaft;" Arch. f. Gyn., III., 1872.

28	were delivered in the	37th week—	253 to 259 days.
64	,, ,, ,,	38th ,,	260 to 266 ,,
102	,, ,, ,,	39th ,,	267 to 273 ,,
177	,, ,, ,,	40th ,,	274 to 280 ,,
140	,, ,, ,,	41st ,,	281 to 287 ,,
81	,, ,, ,,	42nd ,,	288 to 294 ,,
39	,, ,, ,,	43rd ,,	295 to 301 ,,
13	,, ,, ,,	44th ,,	302 to 308 ,,
6	,, ,, ,,	45th ,,	309 to 315 ,,

Calculation of probable date of delivery.—The most convenient practical rule for calculating the date of delivery is based upon the fact that 278 days is the average time from the termination of the last menstrual period, taking the mean of the observations of different authors. Hence we get the following table for calculating the date of delivery.

Average duration 278 days.

From	Jan.	1 to Oct.	1=273 (274)	days—	Add	5 (4) days.
,,	Feb.	1 to Nov.	1=273 (274)	,,	,,	5 (4) ,,
,,	Mar.	1 to Dec.	1=275	,,	,,	3 ,,
,,	Apr.	1 to Jan.	1=275	,,	,,	3 ,,
,,	May	1 to Feb.	1=276	,,	,,	2 ,,
,,	June	1 to Mar.	1=273 (274)	,,	,,	5 (4) ,,
,,	July	1 to Apr.	1=274 (275)	,,	,,	4 (3) ,,
,,	Aug.	1 to May	1=273 (274)	,,	,,	5 (4) ,,
,,	Sept.	1 to June	1=273 (275)	,,	,,	5 (4) ,,
,,	Oct.	1 to July	1=273 (274)	,,	,,	5 (4) ,,
,,	Nov.	1 to Aug.	1=273 (274)	,,	,,	5 (4) ,,
,,	Dec.	1 to Sept.	1=274 (275)	,,	,,	4 (3) ,,

In the above table the figures in brackets are to be used in leap-year in place of the others. The mode of using it may be explained by examples. Suppose the last menstrual period ended on Jan. 10, then Oct. 10 will be 273 days (or in leap year 274 days); add 5 days (or in leap-year 4 days) to make up the average interval of 278 days; this will give Oct. 15 as the most probable date for delivery, which is likely to take place within about a week on one side or the other of that date. Again, suppose the last menstrual period ended on March 29, then Dec. 29 will be 275 days; add 3 days to make up the average interval of 278 days, this will give Jan. 1 as the most probable date for delivery.

The following rule, which may be easily remembered, will give the same results as the above table within one day, which is a difference of little consequence, where exact determination is impossible. Take the date of the end of last menstruation; from this reckon nine calendar months forward, or what is equivalent to the same thing, three months back; if the end of February is included in the nine months add 5 days (in leap-year 4 days), if not, add 3 days. Thus, suppose Feb. 10 the last day of menstruation; reckon 9 months forward to Nov. 10, and add 5 days, this will give Nov. 15 as the most probable date of delivery. This rule is exactly correct for nine months out of the twelve; for the remaining three gives an error of only one day. ~~If~~ it be preferred to reckon from the first day of menstruation instead of the last, or if the record of the former day only be preserved, the average duration may be reckoned at 282 days instead of 278, and the same rule applied, with the addition of four days extra.

In confirmation of the calculation derived from the date of last menstruation, the date of quickening, which is on the average at about the seventeenth week, may be inquired for, although it varies so much in different women, that no very positive inference can be deduced from it. Still, it is valuable as a confirmation, if it agrees with the result obtained from the date of last menstruation, while, if there is a very wide discrepancy, this may lead to the detection of cases in which either there is menstruation for a period or two after conception, or in which conception occurs during a period of amenorrhœa. If, therefore, the date of quickening is very widely apart from what is supposed to be the seventeenth week, it is well to estimate the size of the uterus by abdominal examination. This should be done in any case where it is of importance to have a correct estimate of the date of pregnancy, as when premature labour is to be induced in cases of pelvic contraction. The position of the fundus uteri at the several months has been already described. (See p. 106.) The estimate may best be made in the middle months of pregnancy, from the fourth to the seventh, and it must be remembered that the height generally assigned to the fundus uteri at the fifth and sixth months is too low, and that the fundus generally reaches the level of the umbilicus at the fifth calendar month or soon after, not at the sixth. The distance of the umbilicus from the pelvis, however, varies in different cases, and there are two methods which give a more accurate result, the first that of measuring the height of the fundus uteri above the pubes; the second, that of measuring the length of the fœtus itself, as it lies within the uterus. For the first method, the position of the fundus is made out by palpation and percussion, and the distance from the point so determined to the pubes is measured by callipers. In order to ascertain the length of the fœtus *in utero*, one arm of the callipers is introduced into the vagina, and placed upon the lowest point of the head, the uterine wall intervening; the other arm is placed on the outside of the abdomen on the highest part of the breech.

For results of value to be obtained from the method of estimating the height of the fundus uteri, it is necessary that the fœtus should be normally placed in the uterus. The other method is available whenever the long axis of the fœtus can be brought into such a position that it can be measured by the callipers.

The figures in the first two columns of the following table are mainly taken from those of Sutugin,* which do not differ greatly from the results obtained by Ahlfeld.† The height of the fundus uteri above the pubes may also be estimated by a tape measure; but this does not give so accurate a result as measurement by callipers. The average measurements taken by this method, according to Spiegelberg,‡ are given in the last column of the following table. The figures in the lower part of the first column, from the twenty-sixth to the sixteenth week are based upon my own observation, the averages given by Sutugin being taken from only one or two cases.

Week of pregnancy.	Height of fundus uteri above pubes measured by callipers.	Length of fœtus measured in utero.	Height of fundus uteri above pubes measured by tape (Spiegelberg).
	Inches.	Inches.	Inches.
40	10·0	9·7	13·2
38	9·6	9·5	13·0
36	9·3	9·2	12·5
34	9·0	8·8	12·0
32	8·7	8·3	11·5
30	8·3	7·9	11·0
28	7·8	7·6	10·5
26	7·3	7·2	8·5
24	6·6	...	
22	6·0	...	
20	5·4		
18	4·7		
16	4·0		

According to all three authors, the height of the fundus, in the horizontal position of the woman, continues to increase progressively even in the last few weeks of pregnancy, and the sinking of the fundus in the last two or three weeks, so often spoken of, exists only in the standing position. The method of measuring the fœtus itself, instead of the height of the fundus, is preferable, especially in cases of pelvic contraction, when the fœtal head cannot lie partially in the pelvis, and the fundus is therefore unduly elevated.

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* "On the means of ascertaining the Length of Gestation," &c., Obstet. Journ. of Gr. Brit. and Ireland, Vol. III., 1875.

† "Bestimmungen der Grösse und des Alters der Frucht;" Arch. für Gynæk., Bd. II., p. 352.

‡ "Lehrbuch der Geburtshülfe," 2nd ed., p. 111.

Hygiene of pregnancy.—Pregnancy being a natural physiological condition, the ordinary mode of life, provided it is a healthy one, should not be too much departed from. Under normal circumstances, an increased supply of nourishing food is generally required, but it should be given in the most digestible form. It is of great importance to keep up a reasonable amount of exercise in the open air, to preserve the muscular system in good tone. Women of the labouring class, who work in the open air throughout pregnancy, pass through their confinements with much greater ease than those who lead sedentary lives. It is reasonable to expect that women who spend a great part of the day in bed, or on a sofa, will be ill-prepared for the severe muscular effort required in labour. On the other hand, excessive fatigue, strains, and the lifting or carrying heavy weights are to be avoided. Women should be protected as far as possible from any fright, mental shock, mental distress, or undue excitement. Constipation is to be guarded against by diet as far as possible, but violent purgatives should be avoided. Baths may be used according to the ordinary custom, and the genitals should be frequently washed with warm water; but some degree of caution is required as to vaginal injections. They may be used if there is leucorrhœa, but they should neither be very hot nor very cold, and the injection should not be made with much force. It is not usual to abstain from marital intercourse during pregnancy, although in this respect the lower animals set an example to the human race. Coitus is, however, a frequent cause of abortion, and much moderation is desirable, especially during the first four months. If a woman has aborted before, or if there are symptoms of threatened abortion, abstinence during at least the earlier part of pregnancy should be advised.

The dress should be such as to avoid all undue pressure. Garters should be discarded, as tending to promote varicose dilatation of the veins. Stays, if worn, should be made to expand. It is better, however, to use no stays, but have each skirt of petticoat or dress attached to a bodice, so as to hang from the shoulders. In multiparæ, if there is a pendulous abdomen, from laxity of the abdominal walls, involving a tendency to anteversion of the uterus, an abdominal belt should be worn. Great care should be taken that the stays do not press upon the nipples and flatten them. If the nipples are already flattened, a guard may be worn over them, and this may tend to promote their development, but they should not be actively drawn out. The nipples may be hardened, in preparation for lactation, by washing them daily with spirit and water. This care is especially desirable in primiparæ, or if there have been sore nipples in a previous lactation.

The special disorders of pregnancy will be considered hereafter. The general principle is to exhort women to endure the minor inconveniences as unavoidable for the time, and specially to avoid any unnecessary activity in treatment.

CHAPTER XI.

LABOUR.

LABOUR has to be regarded in two aspects, first as a series of vital actions to effect delivery, secondly as a mechanical process, the course of which depends upon the motor forces which act, and the resistances which are called into play by the relations of the passenger to the passages through which it has to pass. The physiological and clinical phenomena of labour will here be first considered.

Causes which determine labour.—The reason why labour comes on so regularly at a definite time is not fully understood. There is reason to believe that menstrual periodicity has something to do with it. The irritability of the uterus increases progressively throughout pregnancy, and it is thought that, although ovulation is suspended, the menstrual nisus does to some extent continue, and that the uterine contractions which are periodically taking place become more active at the times when menstruation would have occurred. Accordingly abortion or miscarriage is more likely to occur at such a time. It is only necessary for the ordinary uterine contractions to be intensified up to the point at which they begin to cause some dilatation of the internal os and pressure of the membranes against it; and then the reflex mechanism is started by which the process of labour thenceforth goes on automatically. It appears that the uterine irritability and the stimulus reach a sufficient intensity to bring this about generally at the time when the tenth menstrual period would have occurred. It remains, however, to explain why this should happen at the tenth menstrual period and not at any other, and this cannot be done in a fully satisfactory manner. It cannot be due simply to the magnitude of the uterine contents having reached a certain point, for, when there is an excessive secretion of liquor amnii, a more extreme distension may be produced in the earlier months of pregnancy without bringing on labour. In many cases of twin pregnancy also, any given degree of uterine distension would be reached at an earlier stage.

In connection with the explanation of the onset of labour, the following facts have also to be explained: (1) In extra-uterine fœtation, if the fœtus lives up to the end of the ninth month, there is a kind of false labour at that time, a decidual membrane is expelled from the uterus, and the fœtus dies about the same time. (2) When one fœtus dies in the case of twins, it is frequently retained within the uterus until the other has reached maturity, and is then expelled with it. (3) An ovum sometimes perishes in the earlier part of pregnancy, but is retained within the uterus for months, and sometimes is only expelled at the end of the ninth month. One of the most plausible theories is that proposed by Sir James Simpson, that, when the fœtus approaches muturity, a change, namely, fatty degeneration, takes place in the decidua, preparing it for separation from the uterus, and somewhat analogous to the change in the stalk of a fruit, causing its separation from the tree when the fruit is ripe. In consequence of this fatty degeneration the ovum is supposed to begin to act like a foreign body, irritating the uterine nerves, and sending a reflex stimulus to the nervous centres by which uterine contractions are excited. This view might explain the causation of false labour in cases of extra-uterine pregnancy, and perhaps also the death of the extra-uterine fœtus at full term, since an analogous change may take place in the extra-uterine placenta.* If the thrombosis in the uterine veins of the placental site, described by some (see p. 75), is a normal occurrence, this will aid in bringing on labour, by producing some obstruction to the blood current through the placenta. It is well known that lack of aërated blood, such as occurs in asphyxia, tends to produce uterine contraction and expulsion of the fœtus.

Spiegelberg proposes the theory that about full term some change takes place in the nutritive requirements of the fœtus, so that it requires some substance not supplied through the placenta, and dies if it does not obtain it; that on the other hand it no longer requires some substance hitherto supplied to it, that this substance accumulates in the maternal blood, acts as a chemical irritant to the nervous centres, and so induces uterine contractions. There seems to be no evidence to support this theory, and neither this nor the last-mentioned will account for a blighted ovum being discharged at the end of the ninth month. It appears possible, therefore, that one of the elements of the causation may be a periodicity inherent, in some inexplicable manner, in the nervous centres, and no more to be accounted for than the menstrual periodicity of twenty-eight days, which itself also appears to have its seat in the nervous centres.

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* According to Leopold, "Studien über die Schleimhaut des uterus," Arch. f. Gynæk., XI., p. 49, fatty degeneration of the decidua before labour is not a constant occurrence, but there is always a change in the layer where separation is to take place, consisting of a thinning of the trabeculæ which hold together the network of spaces which exists at that level of the decidua.

The essential element in the process by which the fœtus is expelled consists in the contractions of the uterus; the auxiliary force supplied by the voluntary muscles is only a minor factor. This is proved by the fact that, in cases of paraplegia, where the abdominal muscles are paralysed, labour may be completed in a natural manner, while, on the other hand, in uterine inertia, where the pains are absent, no voluntary effort can make the labour progress.

Nervous mechanism of uterine contractions.—The uterus is quite independent of any direct control of volition. Contractions may go on rhythmically when a woman is perfectly insensible from apoplexy, from the coma of puerperal convulsions, or the narcosis of anæsthetics. It is, however, much under the indirect influence of emotions. The accoucheur often finds disagreeble evidence of this fact when, in the case of a sensitive woman, his entry into the room is sufficient to banish the pains, which just before were recurring regularly. If he takes his leave in impatience, the pains are apt to return, and the child to be born quickly in his absence. Again, it is found greatly to conduce to the favourable progress of labour to keep up the woman's courage and hopeful anticipation of its conclusion. The effect of mental shocks or sudden frights in bringing on premature uterine contractions is well known. In protracted labour also, the effect on the woman's mind of preparations for the application of forceps sometimes acts as such a stimulus to the pains that artificial assistance becomes needless. After delivery not only will suckling induce a sympathetic contraction of the uterus, but the maternal emotions induced by seeing the infant have the same effect. In these cases a stimulus, or in some cases even an inhibitory action, must be transmitted from the brain to the centres in the spinal cord.

The chief causes of uterine contraction are two: first, periodic centric discharge of nervous energy; secondly, reflex stimulus. The centric discharges of energy are manifested throughout pregnancy by the periodic gentle uterine contractions, alternating with relaxation. The tendency to periodic discharge is preserved during labour, when, though receiving a more or less constant afferent impulse from the nerves of the uterus and vagina, the spinal centres send out their stimulus to the uterus only at intervals. The centric discharge is capable of being excited by certain substances circulating in the blood, such as ergot and other drugs, or an excess of carbonic acid. It is probably also excited by some morbid material in the blood when premature labour is brought on by some zymotic

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disease, more especially small-pox, or by any very serious illness of the mother.

Reflex stimulus may act upon the uterus in two ways, either when it is applied to sensitive cerebro-spinal nerves, or to sympathetic nerves. As instances of the first we have the uterine contractions excited by suckling, or other stimulus applied to the breasts, or by the sudden application of cold to any part of the surface of the body. In labour the pressure of the head upon the vagina and perineum, external pressure upon the perineum, or the introduction of the hand into the vagina to make an examination, have a similar effect in exciting pains. Of reflex stimulus excited by irritation applied to sympathetic nerves, and unaccompanied by pain, we find the chief instance in the nerves of the uterus itself. If the ovum is dead it acts like a foreign body, and generally soon excites the uterus to expel it, although in exceptional cases it may be retained for months. It acts in a similar way as a foreign body if the membranes are separated from the uterine wall over a considerable surface, or if the liquor amnii is allowed to escape and let the uterine wall come into close contact with the fœtus. Again, the mode of inducing labour by passing up a bougie between the membranes and the uterine wall and leaving it there is an instance of reflex stimulus applied through sympathetic nerves. Further, the irritation caused by the dilating pressure of the bag of membranes or the fœtal head upon the cervix is the chief element in the mechanism by which labour goes on automatically when once started.

Arrangement of nerve centres and afferent nerves.—Experiments on animals appear to show that two centres for uterine contraction exist in the spinal cord, one in the medulla oblongata and one in the lumbar portion of the cord, and also that the separated uterus may have in some degree a power of rhythmic action, in virtue of the nerve centres contained in it. The centre in the medulla must be the centre for reflex stimuli transmitted by the cerebro-spinal nerves of the upper part of the body, and this centre appears to be excited to action by the presence of an undue amount of carbonic acid in the blood. The centre in the lumbar part of the cord appears to be that more immediately governing the uterus. Stimuli are transmitted to it through the cord from the centre in the medulla, and indirectly, in the case of emotions, from the brain. The nerves carrying the stimulus to the uterus belong to the sympathetic system, but these derive filaments from the spinal cord through the lumbar and sacral nerves which join the sympathetic plexuses. The body of the uterus is supplied chiefly from the inferior aortic plexus, a central plexus lying upon the bifurcation of the aorta, which receives branches from the lumbar ganglia of the sympathetic as well as from the spinal nerves, and is connected with the ovarian (spermatic) plexus. Lower down the inferior aortic plexus divides into two hypogastric plexuses, one at each side, which supply the rectum and the vagina, and also send branches to the lower part of the body of the uterus and the cervix. Branches from the hypogastric plexus, together with other branches from the second, third, and fourth sacral nerves, unite to form what has been variously regarded as a ganglion, or a plexus including many ganglia, and has been called the *ganglion cervicale uteri.* According to Jastreboff,* there are really two groups of ganglia, the anterior or utero-vesical ganglia, supplying not only the cervix, but the body of the uterus and bladder, the posterior or recto-vaginal ganglia supplying mainly the rectum and vagina, and sending branches to the broad ligaments. These groups of ganglia are situated behind and at the side of the upper part of the vagina. In pregnancy they undergo considerable hypertrophy, and form in all a mass an inch and a half or more in length.

Mode in which the uterus contracts.—The intermittent character of the pains in labour has an important practical advantage both for the mother and fœtus. The relaxation of the pressure on the soft parts allows their circulation to go on freely between the pains, and so diminishes the risk of damage to them from prolonged pressure. The intervals of rest also allow both the nervous centres and the general system of the mother to recover energy. As regards the fœtus, its life would be imperilled by the diminution of the circulation through the uterus and placenta produced by uterine contraction, if the pains were continuous. Thus, when in over-protracted labour the uterus gets into a state of continuous tetanic contraction, the life of the child is generally lost, and the exhaustion of the mother soon becomes very grave.

The contraction of the uterus, like that of other organs having unstriped muscular fibres, is not only involuntary but peristaltic. The peristaltic action is not, however, of a very obvious kind, as is proved by the very different accounts which have been given of it. It has often been said that the contraction begins at the cervix, spreads thence to the fundus, and finally returns to the cervix again. The truth appears to be, that it begins at the fundus and spreads to the cervix. The pressure of the contracting wall on the liquor amnii would naturally cause bulging of the bag of membranes and apparent recession of the presenting part at the commencement of a pain, the membranes being unruptured, a circumstance which has been given as a reason for supposing that contraction begins at the cervix. The time occupied by the wave of contraction in spreading over the uterus is, however, very small as compared with the whole duration of a pain, and therefore the mechanical effect is that of a continuous and not of a peristaltic contraction. In the case of those animals where several fœtuses are contained in one horn of the uterus, each fœtus in turn is conveyed to the vagina by a true peristaltic action, and the direction of the wave of contraction is then from the fundus to the cervix.

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* "On the Ganglion Cervicale Uteri," Obst. Trans., Vol. XXIII.

The uterine contractions follow a certain rhythm, but this rhythm varies in the course of labour. Each pain has a period of increase, a period of greatest intensity, and a period of decline. Then follows a period of complete relaxation, considerably longer than the whole pain. As labour advances and the uterine cavity becomes smaller by the progress of the fœtus, the uterine walls necessarily become thicker. The pains then become more vigorous, especially if there is considerable resistance, and at the same time the rhythm is altered. The intervals become less in proportion, and in each pain the period of greatest intensity is prolonged while the periods of increase and decline become relatively less. If the uterine muscles and nervous centres are well nourished, the intensity of the pains is increased in proportion to the resistance encountered, so long as the woman has not become exhausted.

Polarity of the uterus.—The circular muscular fibres of the cervix do not contract in conjunction with the rest of the muscular wall ; but, on the contrary, there is a nervous correlation between them of such a kind that, with contraction of the body of the uterus, and especially with regular, rhythmical, intermittent, expulsive contractions, such as occur in labour, there is associated a physiological yielding of the sphincter muscles of the cervix, including both internal and external os. Conversely, when the body of the uterus is inactive, the circular fibres of the cervix are generally in action, and mechanical dilatation of the cervix tends to excite contraction in the body of the uterus. These facts were made the basis of rather a fanciful description by Reil,[*] who held that in the uterus contraction and expansion are forces naturally in equipoise, but capable of polar divergence. His view was, that in the unimpregnated uterus there is no divergence of the forces, contraction predominating ; that in pregnancy expansion retreats to one pole, the fundus, and contraction to the other pole, the cervix ; but that, on the onset of labour, contraction leaps over, as in an overcharged jar, from the cervix to the fundus, and expansion retreats to the cervix ; while, after delivery, the forces again come into equipoise, with a preponderance of contraction.

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[*] See Reil, Archiv f. Physiologie, VII., p. 415, 1807 ; and Champneys' "Notes on Uterine Polarity," Obstet. Journ., VII., 1880.

The term "polarity of the uterus" is a convenient one, as a concise expression of the facts, but, in reality, the explanation of the phenomena seems to be a simple one, and to show no real analogy to electric polarity. The nervous correlation by which the action of the detrusor muscle is associated with physiological yielding, not merely passive stretching, of the sphincter muscle which retains the contents of the cavity is shared by the uterus with other hollow viscera, such as the rectum and bladder, and in all cases the arrangement subserves the same obvious purpose. In the case of the uterus the physiological yielding and relaxation in labour appear to affect not only the cervix, but the muscular wall of the vagina. In all the cases spasm of the sphincter is apt to be associated with inactivity of the expulsive muscle. In the uterus, however, there seems to be a further nervous correlation. In order to make labour go on automatically when once started, it is arranged that the stretching of the cervix by the bag of membranes or the fœtus should cause by reflex action expulsive contraction of the body. The same tendency is shown by the uterus, to some extent, at other times, even when unimpregnated. Thus in cases of hæmorrhage, with laxity of the fundus and a narrow cervix, mechanical dilatation of the cervix will sometimes arrest the hæmorrhage by stimulating the body of the uterus to contract and close the vessels. Similarly, at any stage of pregnancy, mechanical dilatation of the cervix will generally set up expulsive pains. Whether or not it be called polarity, this relation between the body and the cervix is frequently exemplified ; and when from any nervous aberration, whether of local or general origin, there is an abnormal condition of the one, the condition of the other is usually modified in the converse direction. Thus, when there is a spasmodic contraction or "trismus" of the os or cervix uteri, there is almost always a deficiency in rhythmical and regular expulsive pains. If the os can be dilated, the pains will generally come on regularly, and conversely, if rhythmical pains can be excited, physiological yielding of the os and cervix will generally take place. It is probable that in the gentle uterine contractions, which take place apart from labour, and are not expulsive in their functions, the strong sphincter fibres which surround the internal os contract with the rest of the body of the uterus, and prevent any tendency to dilatation. Sometimes this may be observed to take place even in labour, when there is a tendency to spasm of the cervix, associated with deficiency of expulsive pains, especially when the liquor amnii has escaped prematurely. The effect of a pain may then be actually somewhat to close up the internal or external os, instead of to dilate it further.

Cause of the pain in labour.—The severe pain which almost invariably accompanies labour is chiefly twofold in its origin. First, there is the pain produced in the uterine muscle itself during its contraction. This is analogous to the pain of colic, and is probably due to compression of the tense filaments. This kind of pain is felt mainly in the abdomen, over the surface of the uterus. Secondly, there is the pain produced by the stretching of the soft parts, the pressure upon them, and also by the strain upon the uterine ligaments and attachments, when the uterine contraction meets with much resistance. In the early stage of labour this kind of pain is due to the stretching of the cervix, and especially of the margin of the external os. The pain so produced is generally a dull, aching pain, and is felt chiefly over the upper part of the sacrum. As the fœtus advances, pain is produced by stretching of the vagina, and especially of the perineum and vaginal outlet. This is often of a violent tearing character, and very intense, especially in primiparæ, since the genital passage becomes more and more sensitive towards its outlet, and in primiparæ, stretching never suffices, and some laceration of the vaginal outlet, at the site of the hymen, is inevitable. In the later stage of labour there is often also pain running down the thighs, and violent cramps in the thighs and legs, due to pressure upon the sacral plexus. The intensity of the pain of labour varies very greatly in different persons, in some degree in accordance with the amount of resistance experienced, but more especially in proportion to the nervous susceptibility of the patient. This applies especially to the pain produced by the contraction of the uterine muscle itself. This in some cases is agonising, while in others it is very easily endurable. In very exceptional cases labour is gone through without any sensation which could be considered as amounting to pain, and labour has even commenced during sleep and been completed without the mother being awakened. In such cases there must have been gradual and easy dilatation, and so little resistance, that a very slight force, perhaps one not much exceeding the weight of the child, has been sufficient to effect delivery.

Effect of the pains on the general system.—During a pain the pulse becomes gradually accelerated till the pain reaches its height; as the pain subsides the pulse falls again, and in the interval of rest returns to its former rate. The acceleration at each pain may be as much as from 20 to 24 beats per minute. If labour is prolonged, there is also progressive acceleration of the minimum pulse-rate. The converse effect on the fœtus, of diminution of the heart-rate, both during a pain, and progressively in prolonged labour, has been already described (see p. 128). There is some elevation of temperature also in labour. Normally it is but slight, but, in protracted labour, it may amount to as much as two or three degrees Fahrenheit. In sensitive women who feel the labour-pains very acutely, labour may give rise to extreme nervous disturbance. Vomiting is frequent, hysterical manifestations are not uncommon; and sometimes at the stage of most acute pain, when the head is passing the vulva, the woman loses all control over herself, and becomes scarcely responsible for her actions. Rigors sometimes occur, without any notable elevation of temperature, especially about the time of full dilatation of the os, and the body is not unfrequently bathed in perspiration.

The Course of Parturition.

Premonitory symptoms.—For a week or two before delivery, the uterus generally sinks deeper into the pelvis, while the fundus, in the upright position of the woman, falls more forward, and thus becomes lower. Symptoms of pressure on the chest and epigastric region are thereby often relieved. From the increased pelvic pressure, there is often frequent micturition, some increase of difficulty in walking, and the vaginal secretion becomes more abundant. There is often also irritability of the rectum at this time; and this, when it occurs, has the advantage of freeing the pelvis from any collection of fæces. Exceptionally in primiparæ, as already described (see p. 107), the internal os becomes expanded by painless contractions, so that the bag of membranes rests upon the external os, but in the great majority of cases the cavity of the cervix remains distinct from that of the uterus until the definite commencement of labour. In some cases, especially in pluriparæ, no premonitory signs at all are noticed, and labour begins quite suddenly. In others, besides the symptoms already mentioned, the uterine contractions which occur throughout pregnancy increase in degree, and eventually become manifest to the woman herself, although they are manifest earlier on examination by another person. Such slight pains may recur for a few hours every evening for several successive days, and occasionally may pass off altogether for some time before merging into actual labour.

Spurious pains.—The name of spurious or false labour pains is given to pains which often occur during the stage preliminary to labour, and which are distressing to the woman, and sometimes lead her to send for her medical attendant, in the belief that labour is actually in progress. They consist of painful uterine contractions which are generally partial and irregular, and are, at any rate, unaccompanied by any physiological yielding of the cervix. They are distinguished by the fact that they produce no dilatation of the os, and are not accompanied by the copious lubricating secretion from the cervix, which is poured out in actual labour. Such spurious pains are often set up by some local irritation, such as digestive disturbance, or accumulation of fæces, and are then relieved by an aperient or enema.

The three stages of labour.—It is usual to divide labour into three stages. The first stage is that of the dilatation of the cervical canal and os; the second or expulsive stage comprises the period from the full dilatation of the os up to the complete expulsion of the fœtus; the third stage is that of the delivery of the placenta.

The first stage.—There are three elements in the mechanism of dilatation of the cervix and os: first, the mechanical stretching by the bag of membranes, or part of the fœtus projecting into the cervix; secondly, the contraction of the longitudinal fibres of the uterus, which draw the cervix open; and thirdly, the physiological relaxation of the circular fibres, which has already been described (see p. 148) as taking place in conjunction with the contraction of the body of the uterus. It follows from the principles of mechanics, that the effect of any given pressure within the bag of membranes in producing a tension of the edge, either of the internal or external os, is directly proportional to the diameter of the os, and therefore vanishes when the os is very small. Hence, if the os is closed to begin with, some dilatation by the stretching influence of the longitudinal fibres must have taken place before the mechanism of dilatation by the bag of membranes, or parts of the fœtus, can come into play. The mechanical action of the dilating part, as it is pressed into the cervix, is that of a wedge: a fluid and uniform wedge, in the case of the bag of membranes; a solid and irregular wedge, in the case of the head or other part of the fœtus. It follows that the effect produced by the wedge varies according to the acuteness of its angle at the points where it is in contact with the edge of the os. In mathematical language, the tension produced on the edge of the os by any given pressure within the membranes is directly proportional, not only to the diameter of the os, but to the sine of the angle which the tangent to the projecting bag of membranes (or to the head when that is acting as dilator), at the point where it touches the edge of the os, makes with the plane of the os. It follows that the dilating force vanishes when there is no projection, and becomes greater the more complete is the projection. It follows, also, that it becomes progressively more and more effective in proportion to the degree of dilatation which has already been produced. It will hence be readily understood why it is that, when the membranes are ruptured, either naturally or artificially, before the os is large enough to allow the head to project much through it, the head forms an extremely bad dilator as compared with the bag of membranes. For it either cannot project into the os at all, or projects so little as to form an extremely blunt wedge instead of an acute one.

The commencement of actual labour is often very indefinite. The preliminary pains, which have been already mentioned, become more marked, though still at first slight and at long intervals. Generally there takes place also a discharge of mucus, tinged with blood. This depends upon separation of the membranes from the uterus near the internal os, or upon rupture of small vessels at the edge of the os, and it therefore indicates that the pains are beginning to be effective in producing dilatation. It is well known to nurses under the name of the "show," as a sign that labour is really commencing. It does not, however, invariably take place.

The internal os is the first to yield to the effect of the pains, and the cervix becomes expanded so as to form one cavity with the body, and allow the bag of membranes with the presenting part to rest upon the external os, before the external os itself undergoes any notable dilatation. This implies that a sufficient portion of the bag of membranes must have been detached from the lower part of the body of the uterus to allow the bag to project into the cervix, and eventually through the external os. The pressure of this detached portion of the ovum, acting as a foreign body, serves as a constant stimulus to the uterus to further contraction, and generally thus ensures the speedy expulsion of the fœtus, although in some exceptional cases, as already mentioned (see p. 107), this state of things continues for some days, or even weeks, before active labour. To this constant stimulus to further contraction is added the intermittent stimulus of pressure on the cervical nerves produced by the pains themselves. This stage will generally have been reached before the medical attendant is summoned. If an examination be then made during a pain, before the os is much dilated, the edge of the os will be felt, especially in primiparæ, as a thin, tense, almost membranous ring, with the tense bag of membranes projecting more or less into it, so that it is difficult to feel the presenting part until the pain has passed off. After a time, as the os begins gradually to yield to successive pains, its edge becomes softer, thicker, and more tumid, and this change is a sign that dilatation will thenceforth proceed more rapidly. In parous women the edge of the os is often found soft and thick when first examined.

The amount of suffering experienced during the first stage of labour varies very much in different persons. As a rule the woman is able to be up and about. As the dilatation advances the pains recur at progressively shorter intervals, but each pain is short, compared with the pains of the expulsion stage, not usually exceeding a minute in length. As a general rule the pain consists of uterine contraction only, and the muscles of expiration are not called into play as auxiliaries. The woman may cry out freely from the severity of the pain, and there is no involuntary holding of the breath for expulsive effort. Towards the end of the first stage the pains often recur more frequently than the more prolonged and vigorous pains of the expulsive stage, and to women of a susceptible nervous temperament they may be more distressing, partly because the woman does not feel that progress is being made. When the pains are frequent the pulse may become more rapid, sometimes reaching 100, but falls again after the membranes are ruptured, and there are longer intermissions between the pains. Unless the first stage has been very long protracted, and provided that the membranes are not ruptured, this increase of rapidity in the pulse is not of much moment, and has not the same significance as a rapid pulse in the expulsive stage. As the os is dilating, a copious lubricating secretion is poured out by the mucous glands of the cervix, and the vaginal walls become relaxed and dilatable. The presence of this secretion in abundance is a very important practical sign to the accoucheur that the labour is likely to be completed rapidly. It is of value not only from its own mechanical effect, but as an indication that the vagina as well as the cervix is passing into a suitable condition of preparedness. Like the lubricating secretion poured out in coitus, it is greatly under the influence of the nervous system. It is liable to be deficient when there is a tendency to spasm of the cervix, or a deficiency of rhythmical pains, also when there is any source of irritation either from any abnormal condition of the genital passages, or from unduly frequent examination at an early stage of labour. It is also more likely to be deficient if labour is premature, especially if induced artificially.

The bag of membranes, which at first bulges at the external os only in the form of a watch-glass (Fig. 98, p. 209), protrudes more and more as the first stage advances, and eventually may form a sausage-shaped swelling in the vagina (see Fig. 72, p. 155), and even protrude externally at the vulva. When the mechanism of nature is carried out to the greatest perfection, the membranes have just such a strength that, when the os is fully dilated to the width of the expanded vagina, and not till then, the pressure of the liquor amnii is raised by the increasing pains up to a point sufficient to rupture them. The rupture generally takes place at the bulging part; the liquor amnii in front of the head then flows away, and a portion also of the rest.

The head, however, being pressed down into the cervix, fills it up like a ball-valve, and retains a certain part of the liquor amnii. A

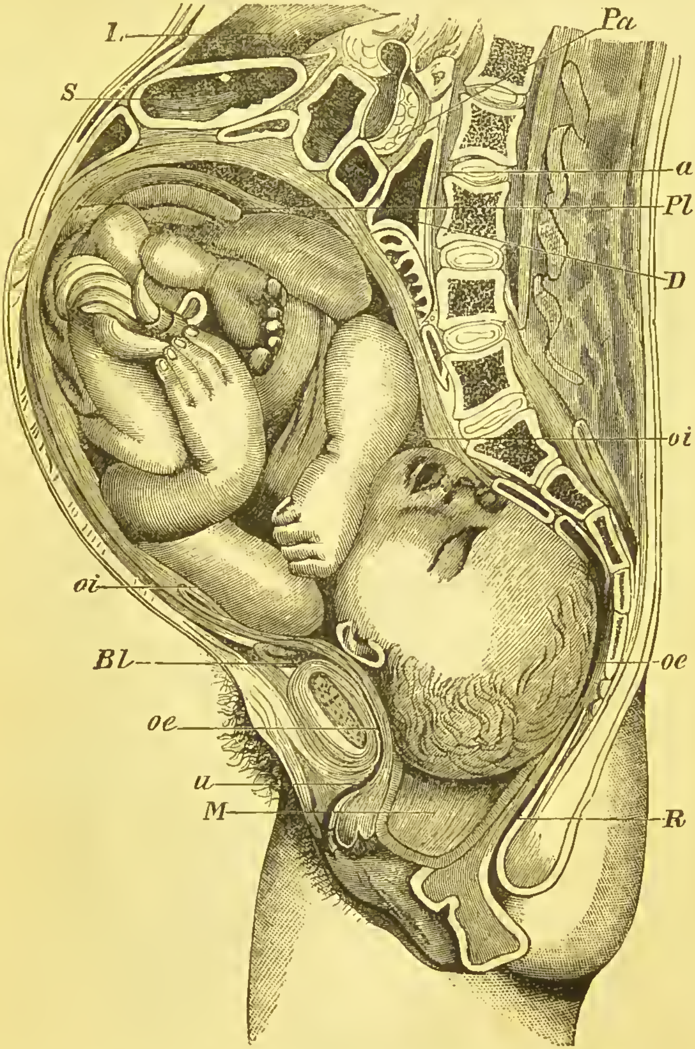

Fig. 72.—From a frozen section of a patient who died in labour, the head having entered the pelvic cavity, but the membranes being yet unruptured. *L*, liver; *S*, stomach; *Pa*, pancreas; *D*, duodenum; *a*, aorta; *Pl*, placenta; *oi*, os internum; *Bl*, bladder; *oe*, os externum; *u*, urethra; *M*, bag of membranes; *R*, rectum. (After C. Braune.)

portion of this is retained until after the birth of the fœtus, but generally a little flows away at the commencement of each successive pain, the uterine pressure beginning to affect the liquor amnii before it has pressed the head into firm contact with the whole border of the os uteri, or of that part of the genital canal which it is entering. Thus the longer labour is protracted the more closely does the uterine wall come into contact with the fœtus. If any other part of the fœtus than the head or breech presents, almost the whole of the liquor amnii flows away immediately. The same result happens, if from contraction of the pelvis the head is arrested above the brim and so prevented from descending into and filling up the os.

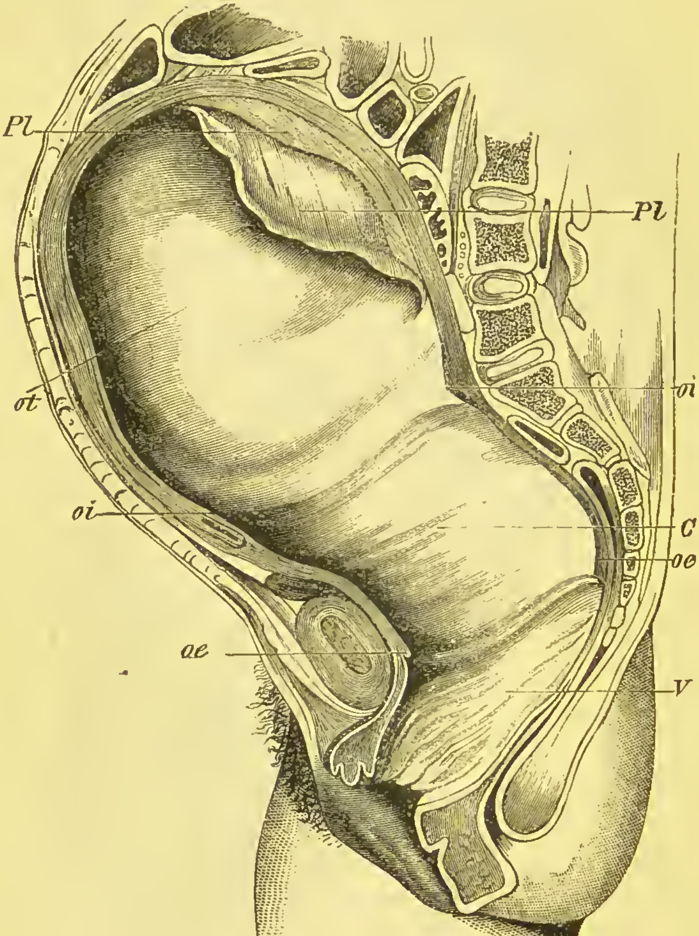

Fig. 73.—From the same section as fig. 72, the fœtus being removed. *Pl*, placenta; *ot*, cavity of uterus; *oi*, os internum; *C*, cavity of cervix; *oe*, os externum; V, vagina.

The termination of the first stage must be defined as being marked, not by the rupture of the membranes but by the complete dilatation of the os, or at any rate by its dilatation to such a point that it offers no obstacle to the advance of the presenting part. When the rupture of the membranes, either by nature or by art, just coincides with such dilatation, it marks the transition from the first to the second stage. The cervix uteri is then converted into a continuous tube with the vagina (see Fig. 73), the vaginal portion of the cervix merely remaining as a flaccid border resting flat against the dilated vagina (*oe*, Fig. 73).

More frequently there is no very well-defined boundary between the first and second stage. The membranes give way, or are ruptured artificially before dilatation of the os is quite complete. The pains then acquire the character of those of the second stage, and the head begins to advance, while there is still a rim of the cervix overlapping the greater diameter of the head, and forming a part of the obstacle to its progress. The effect often is that this rim of the cervix is carried down, to some extent, with the head towards the vaginal outlet. If the membranes rupture still earlier, before much dilatation of the os has been effected, the first stage is liable to be much protracted, and the child's life runs a greater risk. This occurs more frequently in primiparæ, in whom the os presents a greater resistance to dilatation. So long as the membranes are intact, and there is sufficient liquor amnii present, the head is not pressed down at all into the os, before its full dilatation, but on the contrary recedes during a pain. The child being thus only subjected to the equable pressure of the liquor amnii on all sides, its circulation is not likely to be seriously interfered with.

When the membranes are unusually tough and are not ruptured artificially, the bag of membranes may be expelled quite outside the vulva, and even the head may pass through the vulva within the unruptured membranes. The membranes then generally rupture about the situation of the neck, after the birth of the head. The child is popularly said to be born with a caul, and to the so-called caul peculiarly lucky properties have been superstitiously attributed. When the bag of membranes is thus carried down in front of the head, it is usually torn away from the placenta. In most cases the amnion alone forms the caul, the chorion having ruptured at the usual place, and remaining attached to the placenta, but sometimes the caul is formed of both membranes. Still more rarely the whole ovum may be expelled entire, and the child will then be suffocated if the membranes are not ruptured artificially. The uterus acts at a great disadvantage in propelling the fœtus while the membranes are entire, not only because the body to pass through the passages is larger, but because it does not itself gain strength through the diminution of its cavity, and consequent thickening of its walls, on the escape of the liquor amnii. Such an event, therefore, is only likely to happen when the child is small relatively to the pelvis, and the quantity of liquor amnii also comparatively small. Occasionally a certain amount of water escapes early in labour, and a bag of membranes is nevertheless afterwards found presenting. This generally depends on the membranes having been ruptured not at the os but higher up within the uterus, so that after the escape of a portion of the liquor amnii, the opening is more or less closed by the pressure of the presenting part. More rarely there is fluid between the chorion and amnion, and two bags of membranes may then be ruptured in succession. Occasionally also fluid is said to be secreted between the chorion and the uterine wall, and to be expelled with the early pains.

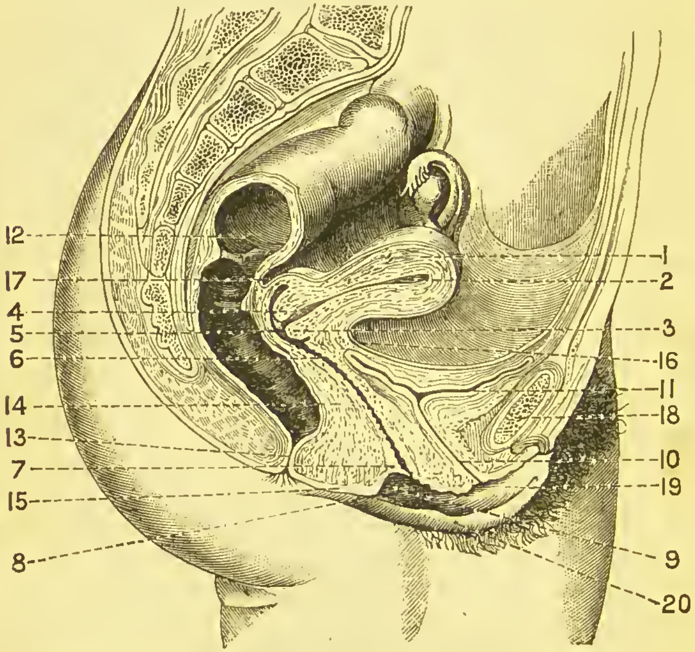

Fig. 74.—Vertical section of pelvis in the virgin. 1, body of uterus; 2, its cavity, 3, the vaginal portion; 4, canal of cervix; 5, lower lip of os externum, forming apex of anterior triangle; 6, vagina; 7, hymen, forming apex of posterior triangle; 8. Fourchette; 9, Fossa navicularis; 10, urethra; 11, bladder, empty and relaxed; 12, rectum; 13, anus; 14, recto-vaginal septum; 15, perineum; 16, vesico-uterine fossa of peritoneum; 17, pouch of Douglas; 18, os pubis; 19, labium minus; 20, labium majus.

Mode in which the cervix and vagina expand.—The soft parts which close the pelvic cavity below and form the pelvic floor, as seen in antero-posterior section, may be regarded as made up of two triangles, the anterior and posterior pelvic triangles.* The apex of the anterior triangle is at the cervix uteri, its base at the pubes. The apex of the posterior triangle is at the edge of the perineum, its base is formed by the lower part of the sacrum and the coccyx. The two triangles are separated by the vagina, which forms a transverse slit, the weakest part of the pelvic floor, and allows one triangle to slide upon the other to some extent (see Fig. 74, p. 158). Of the two the anterior triangle is the most moveable, since its base only is fixed, and its apex moves up and down with the cervix uteri. The lower side of the posterior triangle has its mobility limited by its close connection with the lower end of the rectum, which is held in place by strong muscles, the levator ani and others.

The mode in which the vagina expands in labour is shown by Braune's frozen sections (Figs. 72, 73, pp. 155, 156). The anterior pelvic triangle is drawn upwards, while the posterior pelvic triangle is pushed downward by the advancing head. The two triangles thus open to let the fœtus pass like double swing doors, which swing open in opposite directions, and thus convert the vagina into a wide canal.

The tension produced by the contraction of the longitudinal fibres of the uterus necessarily exercises an upward traction upon the cervix to which they are attached. The anterior pelvic triangle is free to yield to this traction and is accordingly drawn upward, so that the upper part of the bladder is elevated above the pubes (see Fig. 72, p. 155), and the peritoneum is stripped off it. Before the commencement of labour, the whole of the bladder, when empty, is below the level of the top of the pubes. When the anterior triangle has been drawn upward, the lower part of the bladder lies behind the pubes, flattened by pressure of the presenting part. The urine, if any, is contained in the upper part, above the level of the top of the pubes. The anterior margin of the os externum (*oe*, Fig. 73, p. 156) becomes higher in reference to the plane of the brim than the posterior margin. The anterior margin of the os internum (*oi*, Fig. 73) is also elevated as much as 1·8 inches higher above the plane of the brim than the posterior margin. The longitudinal tension has also the effect that the cervix is greatly elongated as well as expanded laterally, and its walls are thereby the more thinned.†

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* See Hart, "Atlas of Female Pelvic Anatomy," pp. 57—67.

† It is not certain that the great elevation of the os internum above the level of the brim shown in figure 73 is to be regarded as a usual occurrence in normal labour. It is true that the pelvis is not contracted, but the membranes are still intact although the os is fully expanded, and the second stage of labour so far advanced, that the head is resting on the pelvic outlet. Labour may have been prolonged, therefore, in

Since the posterior pelvic triangle cannot be drawn upwards as a whole, but, on the contrary, is driven downward by the advancing head (see Fig. 73, p. 156), the posterior wall of the uterus, especially of the cervix, is more thinned than the anterior. Hence arises the greater liability to rupture at the posterior wall. In this instance the retraction ring (see footnote, p. 107) appears to be indistinguishable from the internal os uteri. In proportion as the wall of the uterus below this level becomes thinned by stretching, longitudinal and transverse, so the wall above it becomes thickened by retraction or shrinking, chiefly longitudinal.

Caput succedaneum in the first stage.—If the membranes are ruptured before the os is fully dilated, and especially if the dilatation is long deferred and the pains active, an effusion of serum takes place beneath that part of the scalp, or other presenting part of the fœtus, which projects into the os, and so is unsupported, in consequence of the pressure to which all the rest of the fœtus is subjected. In addition to the serum a small quantity of blood may also be effused. The swelling thus produced is called the *caput succedaneum*, and it may form a prominence elevated for half an inch or more above the surface of the cranial bones. It renders the shape of the head more sharply conical, and thus better adapted for the wedge-like action of dilating the cervix. It therefore tends to compensate, in some small degree, for the loss of the bag of membranes as a dilator. The position of the caput succedaneum as regards the fœtus will be considered hereafter in reference to the mechanism of labour.

Second or Expulsive Stage.—As soon as the membranes are ruptured, if the os has reached the stage of full dilatation, or nearly so, the character of the pains is completely altered. This arises from two causes: first, because the cavity of the uterus is diminished, and its walls thereby rendered thicker and their muscular power stronger; secondly, because there is an increase of reflex stimulus, from the walls of the uterus coming into contact with the fœtus, and the cervix and vagina being pressed upon by the hard head instead of the elastic bag of membranes. Immediately after the rupture of the membranes, the uterus, contracting round the fœtus, appears to take a rest for a short time. Then the pains recur, and are now much more powerful and prolonged, each pain lasting sometimes a minute and a half, or two minutes, instead of less than a minute. At first the pains are often at longer intervals

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consequence of the failure of the membranes to rupture earlier. In a frozen section by Barbour showing the second stage of labour, the head lying slightly lower than in figure 73, the upper part of the bladder is in about the same position, but the peritoneum is stripped off only the front of it, the utero-vesical reflection of peritoneum lying at the level of the top of the pubes.

than those of the latter part of the first stage, and the pulse, in consequence, becomes quieter between the pains. As labour advances they become again more frequent, and as the head begins to press upon and pass through the vulva, pains often come in quick succession, with hardly any perceptible interval, until the head is born. In the expulsive stage, not only are the uterine contractions more powerful, but the woman now instinctively aids them by the expiratory muscles, which act as they do in defecation. These bearing-down efforts, though they are made instinctively, are to some extent under the control of the will. In order to fix the pelvis and the chest, the woman involuntarily places her feet against some support, such as the foot of the bed, and clutches something with her hands, such as a long towel tied to the foot of the bed. A deep breath is first taken, and then the glottis is closed, and all the expiratory muscles put into strong action. The abdominal pressure so produced, besides its own direct mechanical effect, probably stimulates the uterus to more vigorous contraction. In consequence of this action of the auxiliary muscles, the character of the cry is altered in the expulsive stage. There is no longer any loud crying-out during the height of a pain, but instead of this the breath is held, and the silence is broken only by short deep expiratory groans in the intervals between the bearing-down efforts. As the pain is passing off, or when it is just commencing, there may still be loud crying-out.

Although the contractions of the uterus are more violent in the second stage, they are often less distressing than the pains of the first stage. The woman herself feels the presence of a solid body to be expelled, her attention is taken up by the semi-voluntary efforts which she makes to expel it, and her patience is no longer tried by the feeling that no progress is being made. The action of the respiratory muscles must be regarded as reflex although partially under the control of the will. For the bearing-down efforts may take place to some extent, under chloroform narcosis, if not too deep, or in the coma following puerperal convulsions. The auxiliary forces can only act with a closed glottis, and the action of the glottis has been well compared to that of a safety-valve. As the head approaches the outlet of the vagina, which is the most sensitive part of the canal, and where there is most risk of laceration, the pain becomes so intense at the height of a contraction, if a rupture is threatened, that the woman opens her glottis to cry out. The effect is immediately to take off a part of the expulsive force, and so diminish the risk of rupture. Such an outcry generally takes place when the head is just on the point of passing, and the perineum and vaginal outlet are at their greatest strain. Besides the safety-valve action of the glottis, which takes place automatically, the accoucheur may also utilise it to some extent to regulate the course of labour. If the pains are ineffective, and the bearing-down efforts weak, he may exhort the woman to hold her breath, and make stronger efforts; if, on the other hand, the pains are violent and a rupture of the perineum is threatened, he may tell her to cry out, and not to hold her breath.

Under the influence of the pains of the second stage, the head advances intermittently, receding somewhat in the intervals of the pains in consequence of the elasticity of the soft parts. A caput succedaneum is formed more frequently in the expulsive stage than in the first stage, and it now occupies that part of the head which looks in the direction of its motion, and is unsupported by either cervix or vaginal walls, being due as before to the effect of pressure upon all the rest of the fœtus. By the pressure of the head as it descends, the rectum is emptied of any fæces which it may contain. As the head begins to press upon and distend the perineal body, the perineum bulges outward, and at the same time it is elongated and its anterior margin carried forward. The rectum is flattened by the head; the anus itself is carried forward, lengthening the space between it and the coccyx, and, as the apex of the head protrudes through the vulva, the stretching of the perineum drags apart the margin of the anus, and the anus opens to the size of an inch or more, the anterior wall of the rectum resting upon it (see Fig. 75). Eventually the edge of the perineum,

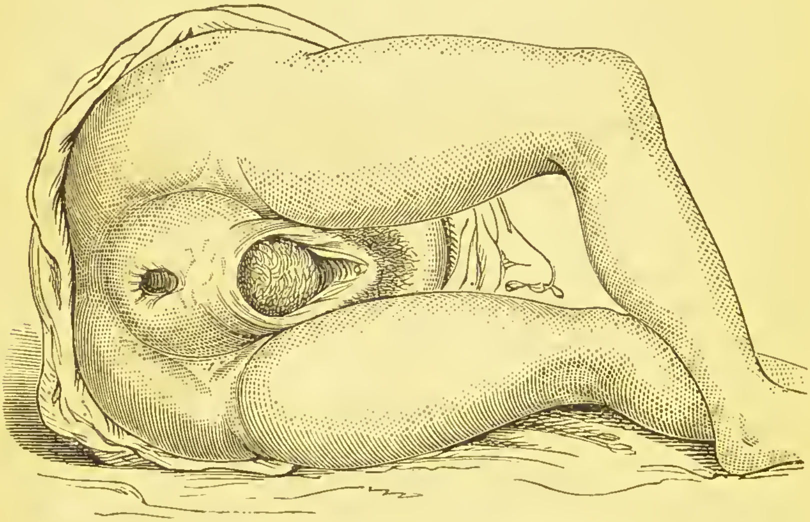
Fig. 75.—Appearance of the vertex at outlet of vulva.

stretched almost as thin as a membrane, forms a ring round the apex of the head, if it has not been lacerated in a previous labour. The perineum may be so thin toward its anterior part, that the sutures of the head can be felt through it. (Fig. 76.) Before this can take place in a primipara, the inevitable laceration at the posterior part of the vaginal outlet, marked by the insertion of the hymen, must have already occurred. By alternate advance and recession of the head, the thin margin of the perineum is gradually stretched. Sometimes the head is arrested at the end of a pain, with the thin ring still stretched over it and intact, but no longer recedes. This has been called the stage of "crowning," and when it occurs, may generally be taken as a sign that the head will pass without any serious laceration of perineum. As soon as the greatest diameter of the head has passed, the elastic and contractile forces of the vagina assist its further progress, and the edge of the perineum quickly slips over it. Slight laceration of the fourchette at this time is very common, but not inevitable. The body is sometimes expelled by the same pain, and generally by, at any rate, the following one, which occurs after a short interval of rest, and is followed by a gush of pent-up liquor amnii, generally mingled with some blood which indicates partial detachment of the placenta. Thus terminates the second stage of labour. The description of the third stage will be deferred till after the consideration of the mechanism of the second stage.

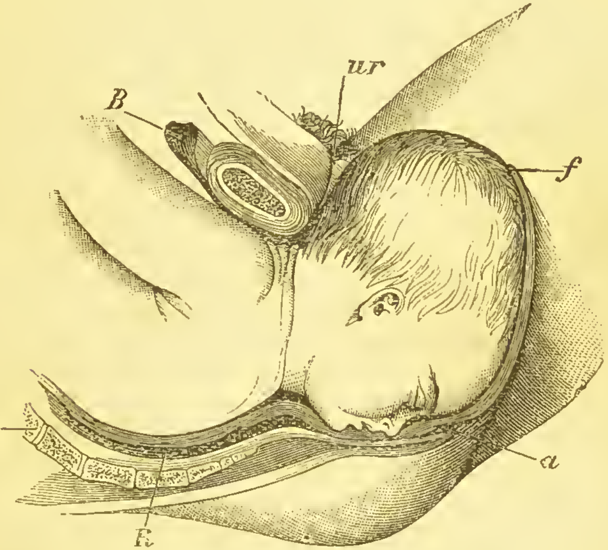

Fig. 76.—Emergence of fœtal head at vulval outlet. 2*S*, second sacral vertebra; *B*, bladder; *R*, rectum; *a*, anus; *f*, fourchette; *ur*, urethra. (After Schrœder.)

CHAPTER XII.

THE MECHANISM OF LABOUR.

THE manner in which the fœtal head passes through the genital canal depends upon the propulsive forces which act upon it, and the resistance which it meets. In order, therefore, to understand the mechanism of labour in head presentations, and the various movements of the head during its passage, it is necessary, in the first place, to study the forces which act upon the fœtus, and the direction of action of each.

The propulsive force produced by a uterine contraction is made up of two parts—(1) the *general intra-uterine pressure*, (2) the *direct uterine pressure* upon the fœtus.

General intra-uterine pressure.—The contracting walls of the uterus pressing upon the bag of membranes in its cavity, filled with liquor amnii, cause a pressure in that fluid which, in general, is uniform throughout every part of it, with the exception of the variation at different levels, due to the weight of the fluid itself. So long as the cervix uteri is closed no propulsive force is thus produced. As soon as the cervix begins to be opened, the pressure in the liquor amnii causes the bag of membranes to bulge through the os. A resultant propulsive force is then produced which tends to force the ovum as a whole forwards through the cervix, but has no action upon the fœtus. Its direction may be inferred from the consideration that it would be neutralised if there were no unsupported part of the bag of membranes, that is to say, if there were an equal pressure acting over every part of the membranes which bulge into the os. The force must therefore be equal and opposite to that which would be the resultant of such a uniform pressure over the bulging membranes; in other words, it acts in the central axis of the os uteri and perpendicular to its plane. If the membranes still remain unruptured after the os uteri is fully dilated, as in such a case as that shown in Fig. 72, p. 155, we must conceive the place of the os uteri to be taken by that circle of the vagina where the bag of membranes ceases to be pressed upon by the vaginal walls, and becomes unsupported.

After the rupture of the membranes, the head usually fills up the cervix uteri or vagina like a ball valve, and a considerable proportion of the liquor amnii is retained within the cavity of the uterus, although a small quantity of it generally continues to escape at the commencement of each pain throughout the course of labour. The general intra-uterine pressure then acts on the upper surface of the head, while that part which projects into the os uteri or vagina is unsupported. The force acting on the head from this cause is equivalent to a fluid pressure equal to that of the liquor amnii acting on the upper surface of the head, including that part which is articulated to the trunk. The reason of this is that the trunk would be in equilibrium, as far as regards the liquor amnii, if a surface of similar fluid pressure were substituted for the area of junction with the head; and therefore the effect of the fluid pressure transmitted from the trunk to the head is the same as if the trunk were removed and the fluid acted directly on the head. Thus results a propulsive force, acting no longer upon the whole ovum but upon the head. It is not transmitted to the head through the condyles, but, in analogy with the former case, its direction is perpendicular to that circle of the head where the head ceases to be pressed upon by the cervix or vagina, as the case may be, and lies in the central axis of that circle.

In general there is free communication between the liquor amnii within the uterus and that in the bulging bag of membranes in front of the head, sometimes called the "fore-waters." During a pain the bulging of the membranes is increased and the head appears to recede. So long as this is the case, the general intra-uterine pressure does not exercise any propulsive force upon the fœtus until after rupture of the membranes. There is one exception, however, to this rule. Sometimes, when the liquor amnii is scanty, and the expulsive stage of labour progresses with the membranes still unruptured, as shown in Fig. 72, p. 155, the head may fit so tightly in the genital canal as to shut off the fore-waters from the liquor amnii within the uterus. The increased intra-uterine pressure due to a pain is then not transmitted to the fore-waters and exercises a propulsive force on the fœtus, due to the excess of the intra-uterine pressure over that of the fore-waters.

It is to be noted that in Barbour's frozen section, representing the second stage of labour, the head near the outlet, liquor amnii intervenes between the breech and the fundus uteri. The chief force at work is therefore the general intra-uterine pressure.

Direct uterine pressure.—Besides the pressure transmitted through the liquor amnii, the uterine walls exercise direct pressure on the body and limbs of the fœtus where they come in contact, and thus produce a force which is transmitted to the head through the fœtal spine and the occipital condyles. If the uterus were to contract like a uniform bag, it would tend, during a pain, to assume a spherical shape, the sphere being that form which has the smallest surface for a given amount of cubic contents. This is not found to be the case. When uncontracted, the uterus lies like a more or less flaccid bag; but, when it contracts, it tends to assume a certain definite form, dependent upon its natural shape, and the relative strength of its muscular fibres. Hence, by German authors, this direct uterine pressure upon the fœtus is called the "form-restitution force." During a pain, a transverse section of the uterus, which, when the woman is lying on her back, is much flattened antero-posteriorly from the effect of gravity, becomes more nearly circular. The longitudinal diameter of the uterus is found to be not shortened but actually lengthened during a pain. This proves that the action of the circular fibres is relatively so powerful that the axis of the

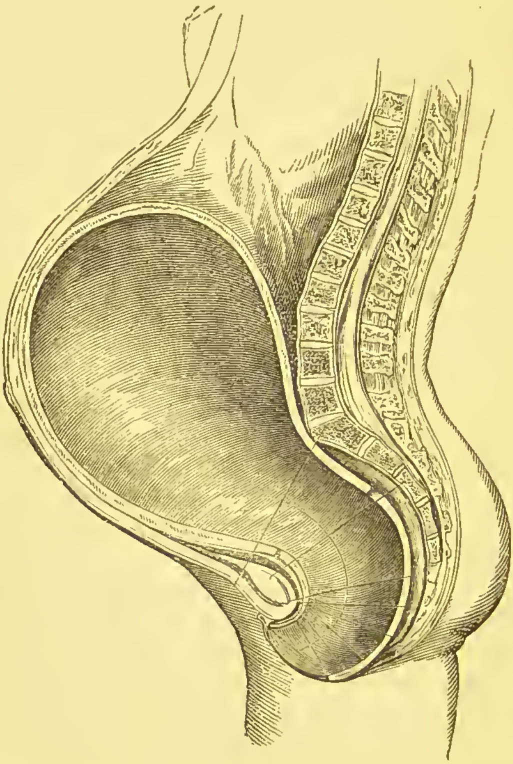

Fig. 77.—The cavity of the uterus, with the parturient canal in a state of full dilatation.

fœtus is straightened by the pain, notwithstanding the pressure on the breech. And thus is explained the fact that the pressure on the breech, due to the action of the longitudinal fibres, is able to transmit a force through the spine to the head without loss, notwithstanding the pliant nature of the fœtal axis, that axis being supported on all sides by the circular fibres, and so prevented from bending.

The direction of the force resulting from the direct uterine pressure on the fœtus is approximately parallel to the axis of the uterus. The direction of the axis of the uterus during labour is generally considered to be normally nearly coincident with the axis of the pelvic brim, but varies to some extent either in consequence of the common deviation of the fundus uteri toward the right side, or in accordance with the position of the woman. In the absence of a pain, while the woman is lying on her back, the fundus uteri is inclined backward in reference to the axis of the brim, a position which is seen also in the frozen corpse (Fig. 72, p. 155); but during a pain, in the second stage of labour, the fundus becomes more or less thrown forward, in consequence of the descent of the diaphragm produced by the preliminary deep inspiration. When the woman stands upright, on the other hand, the fundus is apt to be inclined forward in reference to the axis of the brim, if the abdominal walls are lax. On the whole, the average direction of the axis of the uterus may be regarded as being slightly inclined posteriorly in reference to the axis of the brim (see Fig. 77, p. 166). This implies a corresponding inclination of the force due to direct uterine pressure.

Auxiliary forces.—In the expulsive stage of labour, when the auxiliary muscles come to the aid of the uterus, the first step is that, at the onset of a pain, the woman takes a deep breath and then closes the glottis, thus fixing the diaphragm. This descent of the diaphragm depresses somewhat the fundus uteri, and thus brings the uterine axis more nearly into coincidence with the axis of the brim. The glottis remaining closed, the expiratory muscles of the abdomen and chest compress the abdominal contents, just as in defecation or micturition, while the diaphragm remains passive. The abdominal pressure thus produced acts over every part of the outside of the uterus except those which are below the level of the stratum of cellular tissue in the pelvis forming the floor of the abdominal cavity. The part of the uterus thus pressed upon coincides nearly with that part of the muscle which is actively contracting. The effect of the auxiliary muscles is therefore to add to each of the resultant forces already mentioned, namely the general intra-uterine pressure, and the direct uterine pressure on the fœtus. It has also another influence of great practical value, namely, that it tends to press the uterus downwards, as a whole, towards the pelvis. This takes off the tension placed by the uterine contractions on that lower distensible uterine segment which intervenes between the strong retracting or thickening part of the muscle (see p. 159), and the attachments of the uterus to the pelvis, and which accordingly is the part of the uterus most liable to rupture. Thus the tendency to rupture of the uterus is resisted by an efficient action of the auxiliary muscles, and is more likely to occur if the abdominal walls are weakened by fat or over-distension.

In a protracted labour, as the liquor amnii gradually escapes more and more completely, the uterine walls come into closer contact with the fœtus, and thus the relative importance of the general intra-uterine pressure becomes progressively less, and that of the direct uterine pressure on the fœtus progressively greater. This will happen the more rapidly if any deformity of the pelvis prevents the head descending into it sufficiently to act effectively as a ball-valve. It will be observed that the force exerted by the general intra-uterine pressure on the head is always perpendicular to that circle of the soft parts which the head is at the moment entering, and therefore acts always at the greatest possible advantage. That produced by the direct uterine pressure acts nearly in the axis of the brim until the head is so far advanced that the trunk meets the inclined pelvic floor (see Fig. 76, p. 163). It then becomes inclined more forward, but still does not act so strictly in the direction in which the head is advancing as the other force. It is therefore an advantage if, in the later stage of labour, a considerable quantity of liquor amnii is still retained.

Magnitude of the forces acting in labour.—The force exerted by the uterus is of much greater magnitude and importance than that produced by the auxiliary muscles. This is proved by the fact that, if pains are absent, no voluntary effort is effective in forwarding labour. Matthews Duncan * ascertained experimentally the force necessary to rupture the membranes, and found it to vary from 4½ to 36lb., the average being 15lb. He inferred that the minimum force necessary to complete labour does not much exceed that which ruptures the membranes, and believed that the force naturally expended does not often exceed 50lb. Schatz endeavoured to measure the force directly by manometer, and found it to vary between 17 and 55lb.

The natural rupture of the membranes at a certain time, which normally should correspond to the completion of the first stage, depends upon two factors, first the increase in size of the os uteri,

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* "Researches in Obstetrics," p. 299.

and, secondly, the progressive increase in the force of the pains. Supposing the pressure of the liquor amnii to remain constant, the effect of that pressure in producing tension, and therefore tendency to rupture, of the enclosing membrane, is proportional to the radius of that sphere which corresponds in curvature to the projecting bag of membranes at any point. While the os is still small, the protruding membranes form a segment of a small sphere, but as the os enlarges, the corresponding sphere also enlarges, and with it the strain upon the membranes, even apart from any increased vigour in the pains.

Resistances.—The movements of the head and other parts of the fœtus in passing through the pelvis are determined by the directions of the resistances they encounter. It has already been explained (see p. 15) that the pelvis is so shaped that it corresponds, in a degree, to a female screw. The largest diameter gradually changes from a transverse to an antero-posterior direction, as it is traced from above downwards, and the anterior and posterior inclined planes of the ischium are so arranged that the left anterior and right posterior quarters of the pelvis combine to form a portion of a screw with a turn from left to right, the right anterior and left posterior quarters another portion of screw with the opposite turn, namely from right to left. When the head reaches the floor of the pelvis it meets an inclined plane sloping forwards, formed, first, by the lower part of the sacrum, secondly by the coccyx with the muscles attached to it, thirdly by the soft parts between the coccyx and the anus, together with the recto-vaginal septum which lies flattened against them, and finally by the perineal body. This inclined plane, as it exists in a multipara when the vaginal canal is as yet only partially dilated, is well seen in the section from a frozen body, shown in Fig. 73, p. 156. In a primipara, the perineal body extends much further forward, and its position, when fully distended by the advancing head, is shown in Fig. 76, p. 163.

The movement of the presenting part, as it approaches the outlet of the soft parts, is much affected by the shape of the strong muscle which virtually forms the sphincter of the vagina, namely the anterior portion of the levator ani (Fig. 78, 2′). The main attachments of this are anteriorly to the posterior surface of the pubes, and posteriorly to the sphincter ani, with which it blends, and through the medium of this, to the coccyx. Hence, when the pelvic floor, driven down before the advancing fœtus, is bulged outward, and the anterior portion of the levator ani stretched open, this muscle being attached most firmly anteriorly and posteriorly and comparatively free at the sides, takes the form of an ellipse, with its long diameter antero-posterior. In easy labours, when the presenting part does not fit tightly to the bony pelvis, the shape of this elliptic opening has more to do than that of the pelvis with the rotation of the long diameters of the presenting part into the antero-posterior diameter of the outlet.

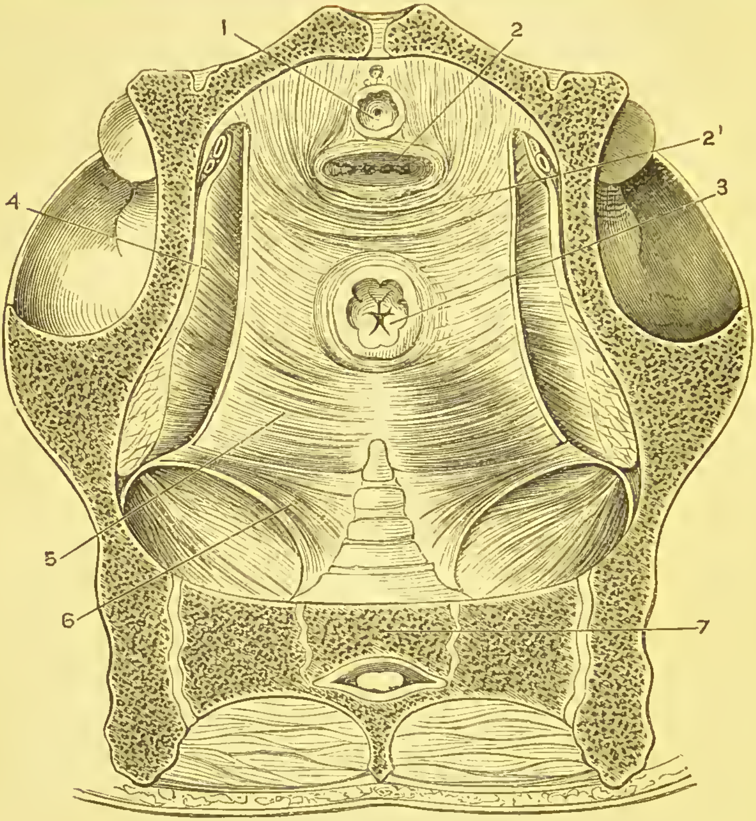

Fig. 78.—Muscles of pelvic floor seen from above. 1, urethra; 2, vagina; 3, rectum; 4, obturator internus; 2', anterior fibres of levator ani, encircling vagina; 5, middle fibres; 6, posterior fibres; 7, sacrum.

POSITIONS OF THE HEAD IN VERTEX PRESENTATIONS.

The head, as it enters the brim, may occupy almost any diameter of the pelvis. The simplest classification is that adopted by British authors, according to which the pelvis is divided in four quadrants by antero-posterior and transverse lines, and four positions of the head are described according to the quadrant in which the occiput

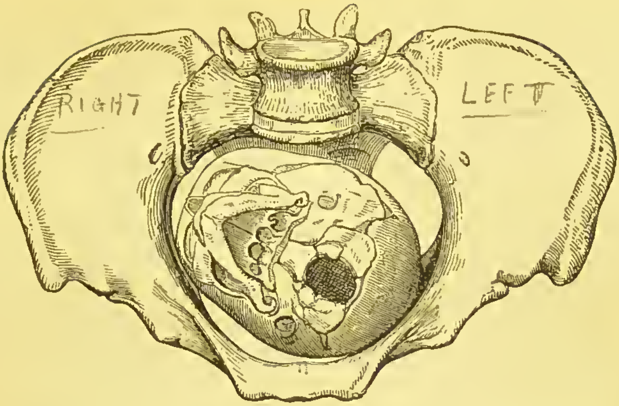

Fig. 79.—Brim of the pelvis, and base of the fœtal skull in the first cranial position.

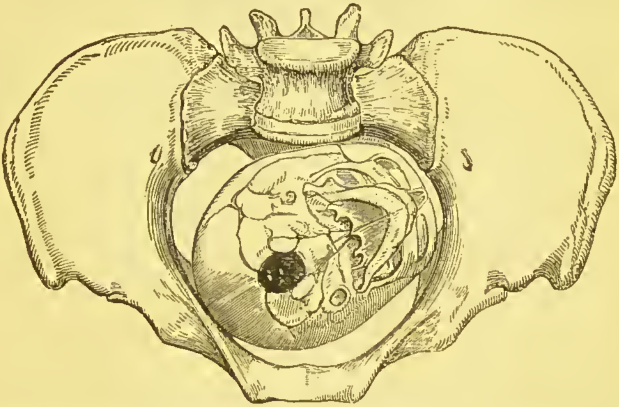

Fig. 80.—Brim of the pelvis, and base of the fœtal skull in the second position.

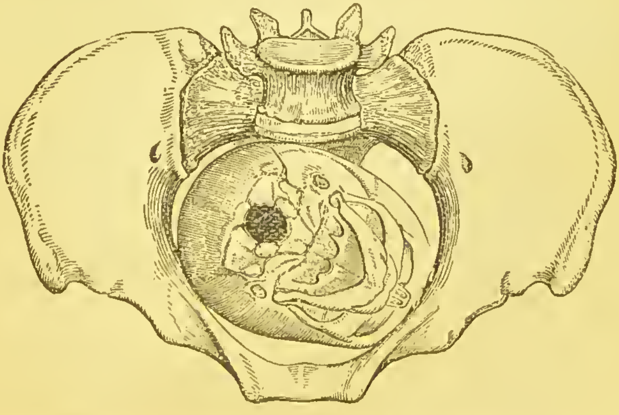

Fig. 81.—Brim of the pelvis, and base of the fœtal skull in the third position.

lies. For any other presenting part there will also be four corresponding positions. Again, it is usual with British authors to name the *right oblique* diameter of the pelvis that diameter which passes through the right sacro-iliac synchondrosis, and the *left oblique* that which passes through the left sacro-iliac synchondrosis. It must be borne in mind, that by some continental writers exactly the reverse usage is adopted.

The four following are the positions of the fœtal head :—

First or left occipito-anterior (*L. O. A.*).—The long diameter of the head approximates toward the right oblique diameter of the pelvis. The occiput points toward the left foramen ovale ; the forehead toward the right sacro-iliac synchondrosis.

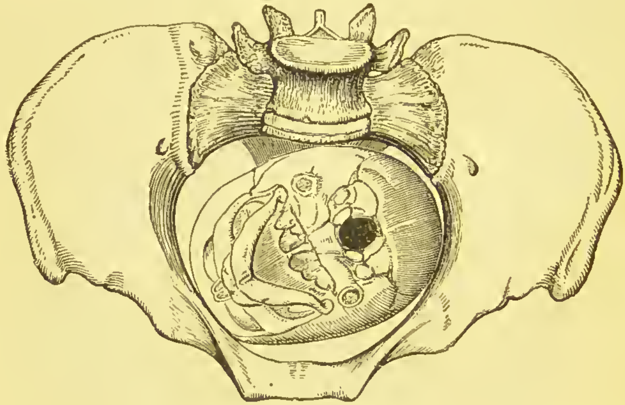

Fig. 82.—Brim of the pelvis, and base of the fœtal skull in the fourth position.

Second or right occipito-anterior (*R. O. A.*).—The long diameter of the head approximates toward the left oblique diameter of the pelvis. The occiput points toward the right foramen ovale ; the forehead toward the left sacro-iliac synchondrosis.

Third or right occipito-posterior (*R. O. P.*).—The long diameter of the head approximates toward the right oblique diameter of the pelvis. The occiput points toward the right sacro-iliac synchondrosis ; the forehead toward the left foramen ovale.

Fourth or left occipito-posterior (*L. O. P.*).—The long diameter of the head approximates toward the left oblique diameter of the pelvis. The occiput points toward the left sacro-iliac synchondrosis ; the forehead toward the right foramen ovale.

It is not meant that in these positions the long diameter of the head lies precisely in any oblique diameter of the pelvis, for, as a rule, it is more nearly transverse than antero-posterior, but only that it approximates more nearly to that oblique diameter than to any other. If the long diameter of the head is exactly transverse, it is regarded as being on the boundary between the first and fourth; or between the second and third positions; if it is exactly antero-posterior (which can only happen in a transversely contracted brim), it is regarded as being on the boundary between the first and second or between the third and fourth.

These four positions of the vertex, or of any other presenting part, such as the face or breech, can at once be deduced if the following two facts are remembered—first, that the back of the child looks forward in the first and second positions, backward in the third and fourth; secondly, that its antero-posterior diameter lies in the right oblique diameter of the pelvis in the first and third positions, in the left oblique diameter in the second and fourth. It should also be remembered that the back of the child is to the mother's left in the first and fourth, to her right in the second and third positions.

It has been mentioned (see p. 4), that, at the pelvic brim, the transverse diameter is the largest. The reason why the long diameter of the head generally enters the pelvis somewhat obliquely and not in the transverse diameter, is two-fold. First, the psoas and iliacus muscles so reduce the transverse diameter at the brim that, in the pelvis clothed with its soft parts, the transverse diameter is not greater than the oblique. Secondly, the initial position of the head is greatly influenced by the position of the body of the child before the onset of labour. The child generally lies in the uterus with its back directed somewhat forward. The main reason for this is that the posterior wall of the uterus is rendered somewhat convex inwardly by the projection of the lumbar vertebræ of the mother. (See Fig. 72, p. 155, and Fig. 77, p. 166.) The fœtus is therefore better accommodated to the shape of the uterus when the fœtal spine is turned away from the spine of the mother.

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If the conjugate diameter of the pelvic brim is contracted, while the transverse is relatively large, the long diameter of the head enters the brim almost exactly in the transverse diameter. In the much more rare cases in which the pelvis is contracted transversely at the brim, to such an extent that its antero-posterior diameter is the largest, the long diameter of the head may enter the brim nearly in that antero-posterior diameter, provided that there is insufficient room for it in the other diameters.

The proportion of cases in which the vertex presents is more than 96 per cent. In about 24,000 deliveries in Guy's Hospital Lying-in Charity it was 96·9 per cent. As to the relative frequency of the different positions of the vertex, very various estimates are given. All authorities agree that the first position is much the commonest, and its frequency is variously given as from 65 to 80 per cent. of vertex presentations. Almost all authorities also agree that the fourth position is much the rarest, and, according to the highest estimate, its frequency is less than 5 per cent. The chief difference of opinion is as to the relative frequency of second and third positions. The cause of the discrepancy is partly that third positions generally change into second, and that the case may be observed for the first time either before or after the change; partly that, when the back of the fœtus is toward the right, the long axis of the head is often so nearly transverse that it is difficult to say whether the position should be called second or third.

It was taught by Naegele that, in 99 per cent. of all cases, the long diameter of the head lay at first in the right oblique diameter of the pelvis, and that second positions, as well as fourth, were excessively rare. The general opinion of modern authorities is rather that primary second positions are about as common as third, so that the frequency of each may be taken as about 15 per cent.

The chief reason why the long diameter of the head so frequently lies in the right oblique diameter of the pelvis is that the left oblique diameter of the pelvis and lower part of abdomen is partially occupied by the rectum and sigmoid flexure, with their contents, and so affords less space. Another cause also contributes to the great frequency of the first or left occipito-anterior position. The pregnant uterus generally not only has a natural obliquity toward the right side, but is rotated somewhat on its axis, so that its front looks toward the right, and its left side is foremost. The left and anterior portion of the uterus therefore occupies the most dependent position when the woman is standing upright. The fœtus, lying in its usual attitude, with the limbs flexed, is most readily accommodated to the shape of the uterus when its antero-posterior diameter nearly corresponds with the transverse, or greatest, diameter of the uterine cavity. Its back is most frequently directed forward and not backward, partly from the effect of the accommodation of the shape of the uterus to the position of the maternal spine, which has been already mentioned (see p. 173), and partly from the effect of the higher specific gravity of the spinal column of the fœtus, when the woman is standing upright. Hence it follows that the back of the child is generally directed to the left side, and somewhat forward.

MOVEMENTS OF THE FŒTAL HEAD.

It has already been explained that the curved axis of the pelvis (Fig. 16, p. 18) is a line drawn to represent, as nearly as possible, the path described by the centre of the fœtal head in passing through the genital canal. While the centre of the head is passing along the curve, the head makes certain rotations on various axes, which it is important to study, in order to understand the mechanism of labour, and its modifications under various circumstances. The mechanism will first be described for the case in which the head lies in the left occipito-anterior, or first, position (L. O. A.). The most important of these subsidiary movements are enumerated as follows :—

FLEXION.
INTERNAL ROTATION.
EXTENSION.
EXTERNAL ROTATION.

Flexion.—While the membranes are still unruptured, and before any expulsive force has begun to act upon the fœtus, the head lies over the os uteri in a variable position, but rather flexed than extended. If liquor amnii is abundant the position may be intermediate between flexion and extension. The two fontanelles are then nearly on the same level, the anterior being perhaps somewhat the lowest, owing to the shape of the head. Both fontanelles can be reached with about the same readiness, and the sagittal suture between them crosses the centre of the presenting part. When, however, the head is so large as to fit tightly into the lower segment of the uterus, the liquor amnii in that part being comparatively scanty, the head is already considerably flexed before the rupture of the membranes, in order to adapt it to the containing cavity. As soon as the membranes are ruptured, and the head begins to meet with resistance, either from the cervix uteri, or other part of the genital canal, a movement of flexion of the chin upon the sternum begins, if flexion does not already exist, associated with the onward movement of the centre of the head along the pelvic axis. By this movement a mechanical advantage is gained, for, when flexion is complete, the greatest diameter of the head which has to pass any plane of the pelvis is no longer the longitudinal or occipito-frontal (*of*, Fig. 52, p. 88), but either the sub-occipito-bregmatic (*sb*, Fig. 52, p. 88), or one nearly approximating to it. The length of the occipito-frontal diameter being about 4·6 inches, and that of the sub-occipito-bregmatic only 3·8, there is thus a gain of about three-quarters of an inch, even without any moulding of the head. Also the maximum diameter of the whole head (*mx*, Fig. 52), instead of lying at all across the pelvis, becomes, when flexion is complete, nearly coincident with the axis of the plane in which the centre of the head is lying.

Cause of flexion.—The cause of flexion is twofold. The first cause depends upon the position of the occipital condyles nearer to the occiput than to the forehead, the second upon the irregular shape of the head. The first cause is the simplest, and in general the most important. Its mode of action is illustrated by Fig. 83. Suppose A C to be a line drawn parallel to the axis of the uterus and passing through the occipital condyles. This will be the direction of the propulsive force, so far as this depends on the direct uterine pressure on the fœtus (see p. 165). The head, in entering any part of the genital canal, will be resisted most at the two extremities of its longest or antero-posterior diameter, O F (Fig. 83), and the resistances at O and F may be considered equal. The head may then be regarded as a lever, balanced about the point C, where the line of propulsive force cuts O F, by the resistances at O and F. Since the anterior arm F C of the lever is longer than the posterior arm O C, the resistance to the forehead will have the mechanical advantage, and the forehead will be retarded more than the occiput. When labour is difficult and prolonged so that most of the liquor amnii drains away, and the direct uterine pressure is the chief force at work, the movement of flexion so produced will generally go on until it is stopped by the chin coming into contact with the sternum, or with the arm of the fœtus, which is often forced down under the chin by the expulsive force (see Fig. 72, p. 155). In easy rapid labour, when the general intra-uterine pressure is the chief force in action, flexion remains more moderate, not perhaps exceeding that which exists in utero. In general, advance and flexion take place together, but it is possible for flexion to occur before advance, if the head is about to enter a strait of the pelvis which is too small to receive it while unflexed. For, during a pain, the occiput may be pushed slightly downwards, and, during the interval, the head as a whole pushed as much backwards by the

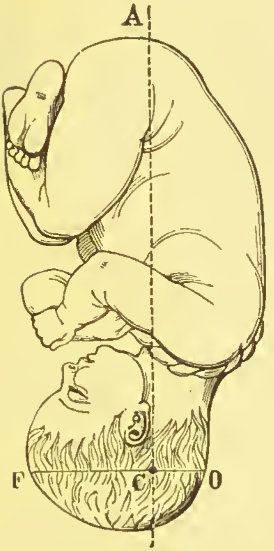

Fig. 83.—Diagram of head lever.

resistance of the elastic soft parts, and the forehead so elevated. In this way the occiput may be slightly depressed, and the forehead slightly elevated alternately until sufficient flexion has been produced to allow the head to advance as a whole into the narrow part, whether constituted by the bony pelvis, the cervix, or soft parts elsewhere.

The second cause of flexion comes into play even if there is no force transmitted through the condyles, the only propelling force being the general fluid pressure, transmitted to the fœtus through the liquor amnii.* It arises from the relation between the shape of the head and the pressure exercised upon it at the girdle of contact either with the os uteri, or the yet imperfectly expanded soft parts elsewhere. The head, looked at from the side, is seen to form an unequal wedge, the slope at the occipital end being steeper than at the frontal (see Fig. 52, p. 88, and Fig. 83). Fig. 84 represents the head, the still imperfectly expanded os uteri forming the girdle of contact. The resultant of the general fluid pressure acts perpendicularly through the centre of the os, in the line F G. The pressures at the girdle of contact (disregarding friction) act perpendicularly to the surface, that is, at the ends of the longest diameter engaged (A B), they act along the lines A H, B H. Their resultant must act through the point H where these lines meet, and it must

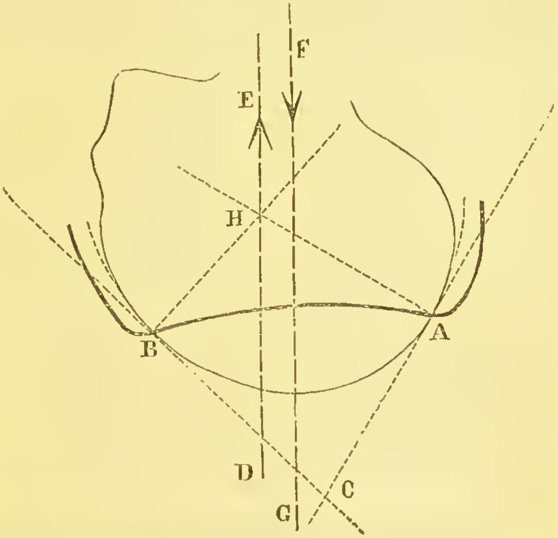

Fig. 84.—Diagram to illustrate the mode in which flexion is produced by the pressure of the girdle of contact on the head.

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* See Lahs., "Die Theorie der Geburt." Bonn. 1887.

act perpendicularly to the plane of the os, if the head as a whole is not being pushed toward the forehead, or toward the occiput, that is to say, it acts in the line D H parallel to F G. We have then two equal forces acting in opposite directions, but not in the same straight line. This forms what in mechanics is called a couple, and it will cause the occiput to descend and the forehead to rise until the tangents at A and B are equally inclined to F G, in which case the point H and also the point C will lie upon F G. If friction is taken into account it will somewhat limit the effect produced, so that the angles which the tangents at A and B make with the plane of the os will not become perfectly equal, but it will not alter its general character. It will be observed that flexion, produced by this cause, need not go so far as to bring the chin into contact with the sternum.

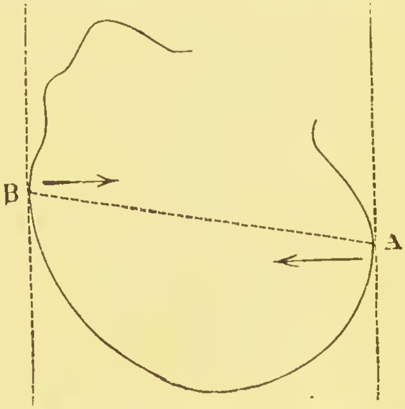

Fig. 85.—Diagram to illustrate the increase of flexion by pressure after the head has entered the genital canal.

A second effect of the pressure of the girdle of contact is produced during the intervals of the pains, when a partial flexion has already occurred. Fig. 85 represents a head in such a position engaged in a cylindrical elastic canal. The pressures at A and B, during the intervals of propelling force, will act perpendicularly to the surface in the direction of the arrows. They will thus, as shown in the figure, form a pair of equal forces, or "couple," tending to rotate the head on a transverse axis, so as to increase its flexion. This kind of pressure will be exercised even by the lower segment of the uterus, especially after the rupture of the membranes. Together with the general tendency of flexor to preponderate over extensor muscles, it is the cause of the flexion existing *in utero*.

The effect of flexion is that, instead of the examining finger touching a point near the middle of the sagittal suture, the posterior fontanelle becomes progressively more within reach, and the anterior fontanelle relatively higher. When flexion is complete the posterior fontanelle may be nearly at the centre of the presenting part and of the caput succedaneum, while the anterior fontanelle may be out of reach, especially when the head is much elongated by moulding.

Internal Rotation.—By the movement of internal rotation the long diameter of the head changes from a position not far from the transverse diameter of the pelvis into the antero-posterior or nearly so. In this rotatory movement, therefore, the head describes rather more than one-eighth of a circle. It emerges beneath the pubes with the sagittal suture directed almost, but not quite, in an antero-posterior direction. (See Fig. 76, p. 163, and Fig. 87.) This is called a *short internal rotation* in contradistinction to the long internal rotation which occurs in occipito-posterior positions.

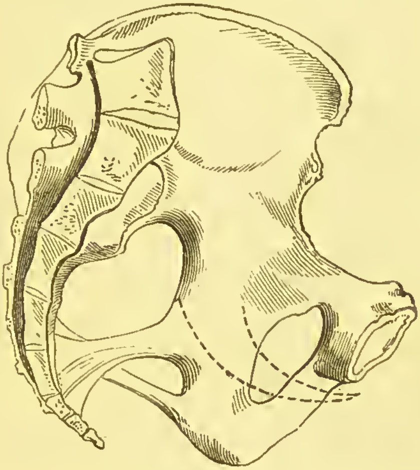

Fig. 86.—Outline of the internal surface of the left half of the pelvis. The two curved lines mark the path of the occiput in the first, and in the occipito-anterior termination of the fourth positions.

Cause of internal rotation.—Internal rotation is due, in the first place, to a screw-like mechanism, the longest diameter of the head accommodating itself as it descends to the longest diameter of the caveted pelvis, which progressively changes from a transverse to an antero-posterior direction. The anterior inclined plane of the ischium (see p. 14, and Fig. 15, p. 16), is the part of the screw which directs the occiput forward, and the posterior inclined plane of the ischium that which directs the forehead backwards, generally at a much higher level. As soon, however, as the occiput has begun to escape beneath the pubic arch, a further mechanism comes into play. The head is then pressed upon by the floor and lateral walls of the genital canal on all sides except in front under the pubic arch, where there is free space. The occiput, therefore, being the part of the head coming in advance, turns away from the resistance into that free space, and would do so even if there were no screw-like form in the pelvis above. It will be seen hereafter this latter mechanism applies to the rotation forward of the occiput in occipito-posterior positions also. Finally, as the head approaches the outlet of the vagina, it is subject to the pressure of the elliptic ring formed by the stretched anterior portion of the levator ani (see p. 169). The shape of this opening completes the screw-like mechanism of the bony pelvis, and has a considerable influence in rotating the occiput forward.

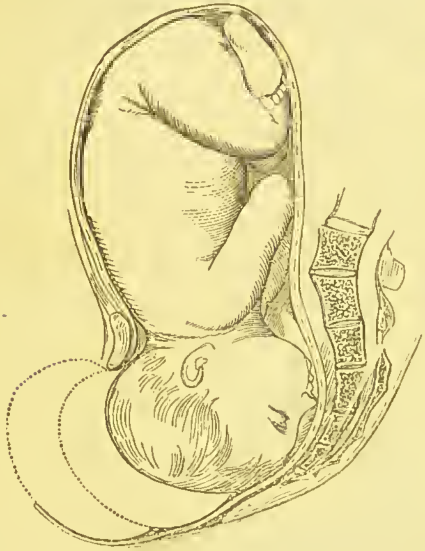

Fig. 87.—Extension of the fœtal head.

Extension. — Flexion is maintained until the head meets the resistance of the inclined plane looking forward formed by the soft parts which constitute the pelvic floor (see Fig. 73, p. 156). The reverse movement of extension then commences. The chin becomes separated from the sternum; the head moves almost as if it were rotating about a transverse axis passing through a point somewhere in the symphysis pubis (except that the movement of internal rotation around a quite different axis is generally also still proceeding). The forehead moves faster than the occiput, having to go along the outside of the curve while the occiput moves along the inside: but no point on the head is arrested, and the posterior fontanelle is nearly in the centre of the part which first appears at a vulva not previously lacerated. (See Figs. 75, p. 162; 76, p. 163.) Eventually, as the head escapes through the vulva, the occiput becomes turned somewhat upward in front of the pubes (see Fig. 87). Meanwhile the perineum and the soft parts behind the anus become greatly stretched, the anus itself expanded, and the anterior margin of the perineum drawn forward (see Fig. 16. p. 18, and Fig. 75, p. 162). The ring formed by the vulval outlet is at its greatest tension when the forehead is just passing the fourchette, and the girdle of contact formed by it then encircles the head nearly in the plane of the suboccipito-frontal diameter (*sy*, Fig. 52, p. 88). If the prominence of the forehead has once passed without rupture, the perineum slips quickly over the face, and, as soon as the chin is released, the extension of the head is diminished.

Cause of extension.—Extension is caused by the resistance of the inclined plane of elastic soft parts looking forward, which forms the pelvic floor, acting in conjunction with the propelling force of the uterus, the direction of which is not far removed from the axis of the brim, except in those cases in which so much liquor amnii is still retained that the main force at work is still the general intra-uterine pressure. This inclined plane is well shown in the frozen sections (Figs. 72, p. 155, and 73, p. 156). Although the membranes are there unruptured, the second stage is shown so far advanced that the head is just beginning to press on the pelvic floor. Further advance in the direction of the axis of the brim is prevented by the resistance of the sloping floor, and the forecoming part of the head which meets the resistance is directed forward. The resistance of the pubes to the aftercoming part of the head and the attachment of the head to the neck prevent the head moving forwards as a whole, and the occiput, its forecoming part, can, therefore, only go forward by a movement of extension. If the front of the child is directed forwards, as in face presentations, or unreduced occipito-posterior positions of the vertex, precisely the same mechanism produces flexion, as will be seen hereafter, and if the head escapes with its long diameter directed laterally, as happens in rare cases only, it produces lateral flexion of the head toward the anterior shoulder.

External Rotation.—After it has emerged from beneath the pubic arch and escaped from the perineum, the head generally rotates back again toward the direction which it occupied at first, the face becoming turned toward the right thigh of the mother. This is due to the effect of the screw-like mechanism of the pelvis on the shoulders and body of the child. The long diameter of the shoulders is from side to side, and, like the long diameter of the head, it accommodates itself to the longest diameter of the pelvis as it descends, turning from the oblique into the antero-posterior. Occupying at first the left oblique diameter of the pelvis, the right shoulder anterior, it turns into the antero-posterior at the outlet, the right shoulder escaping under the pubic arch, the left shoulder sliding over the perineum. The rotation of the shoulders is thus opposite in direction to the previous rotation of the head. Occasionally it happens that the head has rotated completely into the antero-posterior, and the shoulders, following the rotation of the head, completely into the transverse diameter of the pelvis. In this case the rotation of the shoulders is as likely to go on in the same direction as to be reversed. If it does so, the left shoulder comes out under the pubic arch, and the face turns toward the mother's left thigh. Generally, the shoulders only partially follow the internal rotation of the head. The head then makes a partial external rotation suddenly, immediately on its escape, to adapt itself to the position of the shoulders, and a more complete one gradually as the shoulders descend to the outlet. The term *restitution* is sometimes applied to the first sudden movement, and the term external rotation limited to the late and gradual movement. The term restitution was formerly used for the whole movement.

Relation of movements to each other.—It will be observed that the first and third of these movements, flexion and extension, are the reverse of each other, and so also are the second and fourth, internal rotation and external rotation. The movements do not, however, take place separately and successively, but generally two of them are going on together, in conjunction with the descent of the centre of the head. Thus with the descent of the head through the main part of the bony pelvis are combined flexion and internal rotation. As soon as the head meets the inclined plane of the pelvic floor, or rather as soon as the effect of the resistance of this inclined plane preponderates over the forces tending to produce flexion, flexion ceases and extension begins. Descent, internal rotation and extension then go on together until the head escapes from the perineum. At this point external rotation is substituted for its opposite, internal rotation. When, by the elasticity of the soft parts, the head is pushed back in the interval of pains, not only descent, but the other movements are generally reversed for the time, more especially internal rotation. Thus the head recedes, as well as advances, by a screw-like movement. The successive stages, for the first position, are shown in Fig. 88, p. 183.

In the second, or right occipito-anterior position of the vertex, the mechanism is precisely the same as in the first or left occipito-anterior, except that left is substituted for right, and the directions of internal and external rotation are reversed. In the frozen section, Fig. 72, p. 155, the fœtus is seen to be in the second position. The head is beginning to press upon the inclined plane of the pelvic floor, and the force which transforms flexion into extension is thus beginning to act. Internal rotation is not yet complete.

Mechanism in occipito-posterior positions.—Suppose the head to be in the third or right occipito-posterior position, *flexion* takes place as in occipito-anterior positions, and for the same reason. With *internal rotation* the mechanism is different.

The head being well flexed, the occiput advances much in advance of the forehead, and is the first to meet the resistance of the inclined plane of the pelvic floor, which pushes it forward. At the same time there is free space under the pubic arch, and the occiput, therefore, usually turns away from the resisting plane until it is directed nearly forwards, and escapes under the pubic arch. As soon as the occiput has begun to be directed forward, the elliptic opening of the levator ani aids in completing the rotation, as in primary occipito-anterior positions. The position is thus converted into the second or right occipito-anterior, and the movements of *extension* and *external rotation* take place just as if the head had been originally in that position. The internal rotation in occipito-posterior positions therefore takes place through nearly three-eighths of a circle, instead of only a little more than one-eighth (see Fig. 86, p. 179), and is called a *long rotation.*

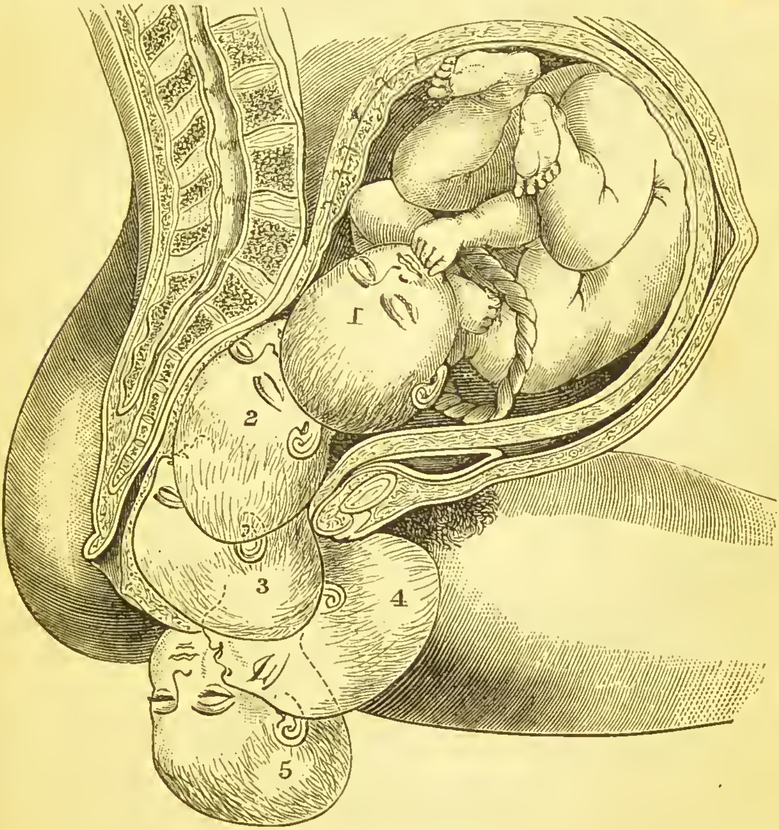

Fig. 88.—Successive stages of first, or left occipito-anterior, position of vertex.

Sometimes this rotation begins before the true floor of the pelvis is reached, and the inclined plane which then causes it is then that formed by the recto-vaginal septum. Whether the rotation occurs early or late, the resistance which causes it is that of the soft parts, and not of the planes of the ischia or any part of the bony pelvis. The screw-like mechanism of the bony pelvis would rather determine a rotation of the occiput *backwards*, since the occiput is originally behind the spine of the ischium. This is further proved by experiment, for it has been shown that if, in the corpse of a woman who has died during or just after delivery, a fœtus be placed in an occipito-posterior position, after the uterus has been opened, and pushed through from above, the rotation takes place in the natural way if the soft parts are intact, but not if they are lacerated, or greatly over-distended in repetition of the experiment.

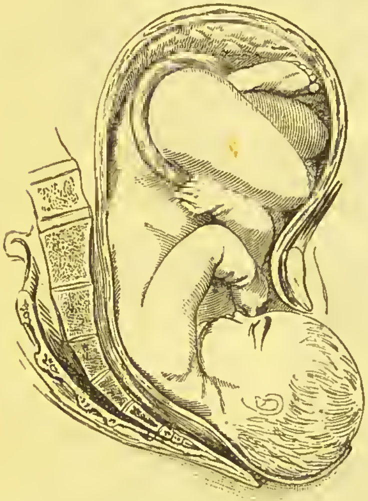

Fig. 89.—Expulsion of the head in the occipito-posterior position.

In the fourth or left occipito-posterior position of the vertex, the mechanism is precisely the same. The occiput usually rotates first to the left and then forwards. The position is thus converted into the first or left occipito-anterior, and extension and external rotation take place as if the head had been in that position originally.

Mechanism in unreduced occipito-posterior positions.—In some cases the rotation forwards of the occiput fails, but probably not in more than about one-tenth of the whole. The occiput is then directed somewhat backwards by the posterior inclined plane of the ischium, in consequence of the screw-like mechanism of the pelvis. Internal rotation therefore occurs in the opposite direction to the usual one, and through only about one-eighth of a circle, the occiput turning back toward the hollow of the sacrum. In this case, therefore, there is a short internal rotation backward. In this position the head reaches the pelvic floor. The resistance of the inclined plane, pushing forward the fore-coming part of the head, then causes a movement not of extension but of flexion (see Fig. 89), and by this movement of flexion the head escapes, the forehead passing beneath the pubic arch, while the occiput passes over the perineum. The occiput, in this case, has to go along the outside of the curve, and therefore moves faster than the forehead. The anterior fontanelle is then often nearly in the centre of the presenting part, as the head is reaching the vulval outlet. This mode of escape of the head involves a serious mechanical disadvantage. (Compare Fig. 89 with 76, p. 163, and Fig. 87, p. 180). Instead of the suboccipito-bregmatic, measuring only 3·8 inches, and finally the suboccipito-frontal diameter either the occipito-frontal measuring 4·6 inches, or a diameter not far removed from it, is opposed to the antero-posterior diameter of the outlet of the genital canal. With a normal size of fœtus and of maternal passages, the head cannot generally so pass, except by rupture of the perineum, until it has been so moulded by pressure as greatly to diminish the occipito-frontal diameter. Even after such moulding, difficulty often occurs, the risk of rupture of perineum is always increased, and artificial delivery is not unfrequently called for.

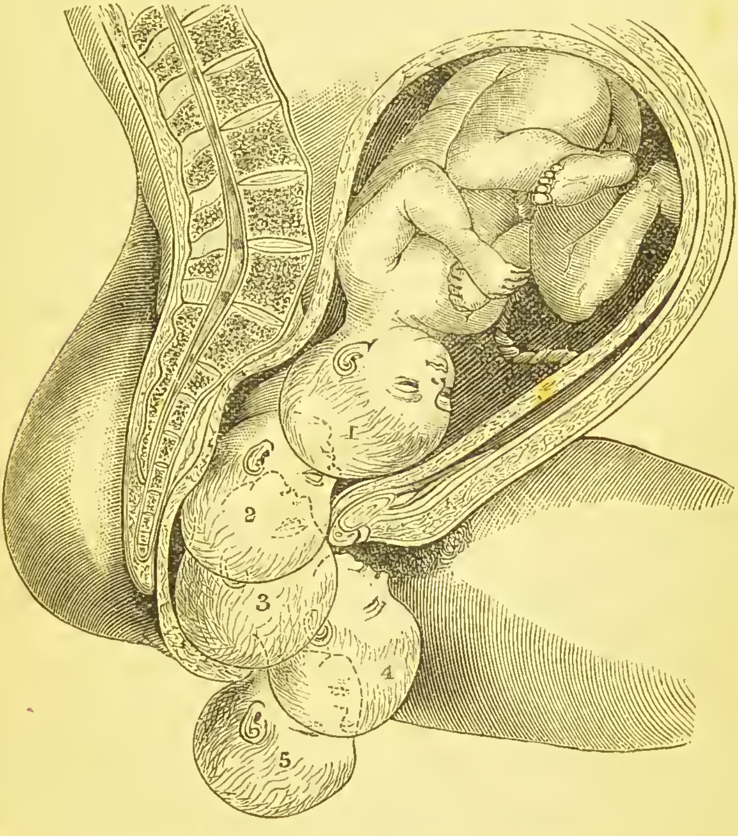

Fig. 90.—Successive stages of fourth, or left occipito-posterior, position of the vertex, when unreduced.

(2) a large foetal head
(3) descent of head into pelvis still cov
by an incompletely d
O.P.

The chief cause of failure of the usual rotation of the occiput forward is deficient flexion of the head, whether this be due to contraction of the conjugate diameter of the pelvis, or any other reason. For the reason why the occiput turns forward, is, as already mentioned, that, coming in advance, it is the first part to meet the inclined plane of soft parts. If, however, the occiput and forehead are descending on the same level, there is no reason why the occiput should be pushed forward any more than the forehead. Even if the flexion is merely less marked than usual, the excess of the pressure forwards on the occiput over that on the forehead may be insufficient to overcome the resistance of friction, or the tendency of the posterior inclined plane of the ischium to direct the occiput backward. The resistance to rotation due to friction will of course be greater the more tightly the head is fitted in the pelvis. Hence a large size of the fœtal head in proportion to the pelvis may be one of the causes which contribute towards the occiput remaining posterior. Another cause may be descent of the head low in the pelvis still covered by an incompletely-dilated os uteri. For the rim of the os uteri, by retarding the occiput, which should escape first, tends to prevent complete flexion.

A final movement of external rotation takes place in unreduced occipito-posterior positions, as well as in other cases. The face turns generally to the side toward which it originally looked; to the left in the third position, to the right in the fourth position. This rotation is due, as before, to the movement of the shoulders in descending through the outlet of the genital canal.

The successive stages of an unreduced occipito-posterior position are shown in Fig. 90, p. 185.

Lateral obliquity of the fœtal head.—In the older works on midwifery, besides the four movements of flexion, internal rotation, extension, and external rotation (restitution), a fifth movement or condition called obliquity was described. By this was meant a kind of lateral or bi-parietal obliquity of the head, which, for distinction, is called the Naegele-obliquity, because it was first described by Naegele.* The Naegele obliquity means a rotation of the head on its antero-posterior axis, so that the anterior parietal bone (*i.e.*, in the first position, the right parietal bone) lies most deeply in reference to the plane of the brim, the middle of the sagittal suture is nearer to the promontory of the sacrum than to the top of the symphysis pubis, and the anterior parietal tuber is in advance of the posterior. By this is implied, assuming the axis of the child to be perpendicular to the brim, a lateral flexion of the child's head toward its *posterior* shoulder, the left shoulder, in the first and fourth positions, the right shoulder, in the second and third. If Naegele-obliquity exists before the os is fully dilated, and the os itself is centrally situated in reference to the axis of the brim, the sagittal suture will divide the os into two unequal parts, the anterior being the largest. In Figs. 91, 92, is shown a slight Naegele-obliquity, still persisting as the head is approaching the outlet of the bony pelvis in the first and third positions respectively. It is to be observed that, even without any Naegele-obliquity, the anterior parietal bone always, when the head is at the brim or in the cavity of the pelvis, lies most deeply in reference to the *horizon*, though not in reference to the plane of the brim, simply in consequence of the oblique position of the long diameter of the head, and the inclination of the brim itself to the horizon.

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* Two other obliquities of the fœtal head at the brim have sometimes been spoken of:—Rœderer's obliquity, by which is meant the chin-flexion; and Solayrès' obliquity, by which is meant the entrance of the long diameter of the head in an oblique diameter of the pelvis.

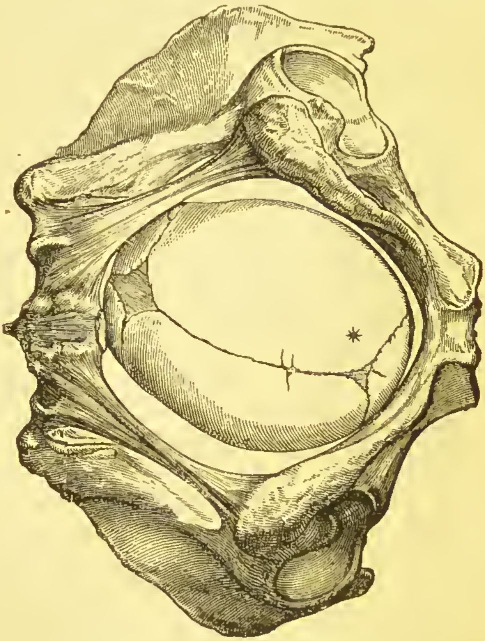

Fig. 91.—Outlet of the pelvis, showing a slight Naegele-obliquity of the fœtal head, which is passing through the pelvic cavity in the first position. The asterisk marks the presenting point. (After Tyler Smith.)

Two among the reasons given by Naegele for inferring the lateral or biparietal obliquity of the head were the following. First that the examining finger, when introduced, touches the right parietal bone (in the first position) in the vicinity of the tuber, and not a point in the sagittal suture. This, however, is simply the result of the head lying in the oblique diameter of the brim, and the inclination of the outlet of the pelvis to the inlet. A second reason was that the caput succedaneum formed before complete dilatation of the os is situated upon the right parietal bone, near its upper edge, and not centrally over the sagittal suture. This, however, may be explained, as it has been by Matthews Duncan, without assuming any lateral obliquity, on the ground that the caput succedaneum will be thickest where the head is least supported. The thickest part will therefore be, not necessarily in the centre of the os uteri, but rather in the direction of the axis of the undilated vagina, while in other parts within the circle of the os uteri, where partial support is received from the posterior vaginal wall, the swelling may be so inconsiderable as not to attract notice. These two points therefore do not prove any Naegele-obliquity, and its existence is only to be inferred when it can be made out that the centre of the sagittal suture is nearer to the promontory of the sacrum than to the top of the symphysis pubis, or that an os uteri situated centrally around the axis of the brim is divided unequally by the sagittal suture, the anterior segment being the larger.

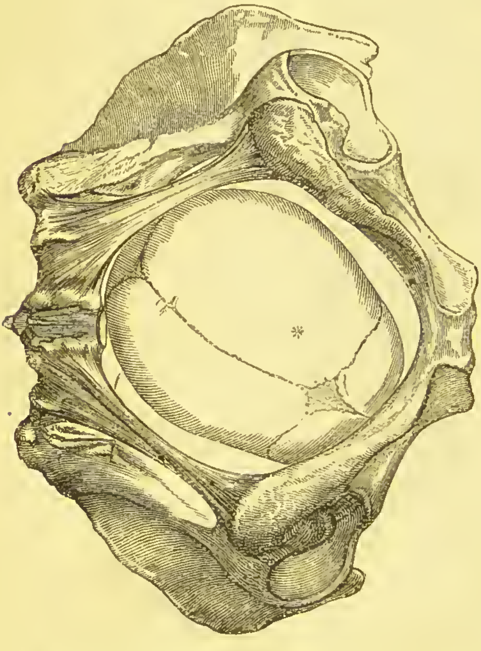

Fig. 92.—Outlet of the pelvis, showing a slight Naegele-obliquity of the fœtal head, which is passing through the pelvic cavity in the third position. The asterisk marks the presenting point. (After Tyler Smith.)

It is now generally held that the Naegele-obliquity is not a regular occurrence in normal labour, and it is quite certain that it does not occur in such a uniform and marked way as to make it deserve to be ranked with the four important movements of flexion, internal rotation, extension, and external rotation. In the case of contraction of the conjugate diameter, however, the Naegele-obliquity is often marked, and the cause of its occurrence in general will be discussed when the mechanism of labour in a pelvis contracted in its conjugate diameter is described. Even, however, when the pelvis can hardly be called contracted, whenever the head passes with difficulty, and has prominent and firmly ossified parietal tubera, so that the bi-parietal diameter is greater than the oblique diameters slightly inclined to it, some degree of Naegele-obliquity is common throughout the earlier part of the passage of the head through the pelvis. It has then the mechanical advantage that the large bi-parietal diameter of the head is never opposed to any diameter of the pelvis, but one parietal tuber, the anterior, always passes a little in advance of the other.

Whether or not any Naegele-obliquity exists in the earlier part of the passage of the head, there is almost invariably, in the later part of the passage through the canal of soft parts, a lateral or bi-parietal obliquity of the opposite kind, by which the head is flexed towards the anterior shoulder (*i.e.*, the right shoulder, in the first position) instead of the posterior. For the occiput is not usually ever rotated quite completely to the front, and moreover the head meets the inclined plane of soft parts (see Fig. 72, p. 155) before even the full amount of internal rotation, which does occur, is finished. The inclined plane then, its resistance being directed forwards—while it pushes the occiput towards the child's back (in occipito-anterior positions), and so causes extension—must at the same time push it towards the anterior shoulder, and so cause lateral flexion.*

Similarly, in unreduced occipito-posterior positions, a lateral flexion of the head toward the anterior shoulder will accompany the movement of chin-flexion by which it escapes under the pubic arch. These varieties of lateral obliquity, like the Naegele-obliquity, are not of sufficient importance to be ranked on a level with the four main rotations as already enumerated.

Moulding of the fœtal head in vertex positions.—Two changes in the head are produced by the pressure on it during labour—first, a general diminution of its size; and secondly, an alteration in its shape, by which the diameters most compressed are specially diminished, a compensatory increase taking place in certain other diameters. The general diminution of the head is produced partly by some of the blood being squeezed out of the head into the rest of the body, and partly by some of the cerebro-spinal fluid being squeezed out of the cerebral ventricles into the spinal canal. Its occurrence is proved by the rapid increase which takes place in the average diameters of the head during a day or two after birth, a period during which the whole weight of the child is somewhat diminishing. The diminution is rendered possible, first by the obliteration of any interval between the bones which existed along the sutures, and, secondly, by the overlapping of the bones. This overlapping takes place in a regular way, in consequence of the anatomical relations of the bones. Both the frontal and occipital bones pass *beneath* the parietal bones, thus allowing a diminution in the antero-posterior diameter of the head. The parietal bones also overlap, and almost invariably, the posterior parietal bone, which is subjected to most pressure, passes beneath the anterior. The movement of the occipital bone is rendered possible by a cartilaginous interval between the posterior and the basilar portion, so that the posterior portion is capable of a kind of hinge movement on the other.

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* Supposing that there is no Naegele-obliquity while the head is passing through the upper part of the pelvis, this lateral flexion might conceivably take place rapidly enough to keep the two parietal tubera on the same level in reference to each successive plane of the genital canal of soft parts, a condition called by German authors the synclitic movement of the head. In point of fact, however, just as the extension of the head is not rapid enough to prevent the presenting point moving progressively forward, relatively to the head, toward the posterior fontanelle, as the head approaches the outlet, so the lateral flexion is not rapid enough to keep the parietal tubera on the same level in reference to the successive planes of the genital canal. The anterior parietal tuber therefore almost always passes each plane toward the outlet of the canal somewhat in advance of the posterior, even when there is no Naegele-obliquity in the upper part of the canal. When the Naegele-obliquity does exist at first, this advanced position of the anterior tuber will be the more marked, because the left lateral flexion will have first to be obliterated, before the right lateral flexion can be produced.

The moulding in shape of the fœtal skull in occipito-anterior positions, and also in occipito-posterior positions which end by rotation of the occiput forward, is shown in Fig. 93, p. 191. The continuous outline is the unmoulded head, the dotted outline indicates the shape after moulding. The points F, B, O in the figure indicate definite points, namely, the root of the nose, and the centres of the anterior and posterior fontanelles, and the diameters are measured to these definite points (see p. 91). The chief diminution is in the suboccipito-bregmatic (SO—B) and suboccipito-frontal diameters, which are successively opposed to the antero-posterior diameter at the outlet. The fronto-occipital diameter, F O, is also diminished, and even the mento-occipital diameter, M O (measured to the posterior fontanelle), is somewhat diminished, instead of being increased, as might at first sight be expected, from the outward appearance of the moulded head. The chief compensatory increase is in the maximum oblique or vertico-mental diameter (M—X), which, when the head is well flexed, lies almost in the axis of the genital canal at the point where the centre of the head is placed. In the unmoulded head the posterior extremity of this is much nearer to the posterior than to the anterior fontanelle (see *x*, Fig. 52, p. 88), but after moulding it runs to a point not far from the centre of the sagittal suture (X, Fig. 93). It will be observed that the change of shape takes place not so much by the movement of the bones upon each other as by the bending of the thinner parts of the bones, more especially of the parietal bones, the curvature of which is greatly altered.

Besides the moulding visible in the antero-posterior section, the head also becomes flattened from side to side, the bi-parietal diameter being especially diminished. The head viewed from the front or from the back immediately after delivery has also an unsymmetrical appearance. This is due to the posterior parietal bone, which has sustained the greatest pressure, being more flattened, and the anterior parietal bone, which has been directed toward the free space of the vagina, having become more convex. Besides the asymmetry due to pressure, there is also a natural asymmetry in the fœtal head, which has already been mentioned (see p. 90). After the effect of moulding has passed off, as it generally does in

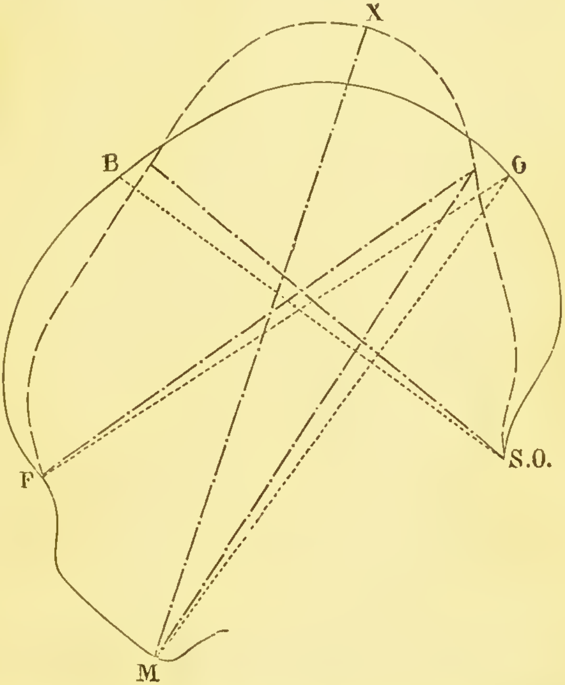

Fig. 93.—Moulding of head in occipito-anterior position of vertex. (After Budin.) The continuous outline shows the shape of the head before, the dotted outline after, moulding.

a few days, or a week at the utmost, this natural asymmetry may become appreciable.

When, in an unreduced occipito-posterior position, the head is delivered without assistance in the usual way, the forehead passing under the pubic arch while the occiput sweeps over the perineum, the moulding, in the antero-posterior section, is very different, and is represented in Fig. 94, p. 192. Here the fronto-occipital and mento-occipital diameters are much more shortened than in the usual position, and the compensatory increase takes place not in the maximum oblique or vertico-mental diameter (M—X, Fig. 93), but in the suboccipito-bregmatic diameter (SO—B), which, in the other case, is so much diminished, and in the vertical or cervico-bregmatic diameter. Sometimes, however, in unreduced occipito-posterior positions, the head is delivered in quite a different way. Extreme flexion takes place at quite a late stage, so that eventually the occiput escapes over the edge of the perineum, while the forehead is still high up behind the pubes. As a rule, this occurs only with a dead child, with which a more excessive moulding of the head is possible, and it is sometimes promoted by delivery with forceps. The kind of moulding is then an exaggeration of that which occurs in occipito-anterior deliveries, as shown in Fig. 93. The elongation of the head along the maximum diameter, M X, is excessive, the head is extremely flattened by the pressure against the pubes, so that there is an almost uniform slope from the face up to the parietal bones, and the back of the head forms an almost vertical line with the neck. Fig. 94 is drawn from measurements taken by the author, so as to correspond with Budin's figures. The figure given by Budin for the moulding in occipito-posterior positions,* and also that of Tarnier and Chantreuil,†

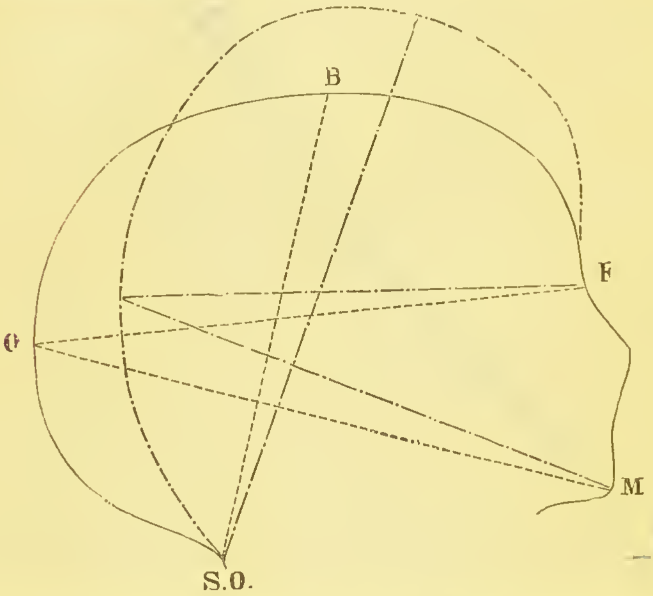

Fig. 94.—Usual moulding of head in unreduced occipito-posterior position of vertex. The continuous outline shows the shape of the head before, the dotted outline after, moulding.

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* "De la Tête du Fœtus au point de vue de l'Obstétrique." Paris. 1876. Pl. XVIII.

† "Traité de l'Art des Accouchements," p. 682.

represents the exceptional case just mentioned, and not the usual condition for a child spontaneously delivered alive. Figures, however, are given by Barnes* and Spiegelberg† which show the same general shape of the head as Fig. 94.

Caput succedaneum.—In addition to the changes in the bony cranium, the appearance of the head is altered by the formation of the caput succedaneum. The cause of its production has been already mentioned (see p. 160). If a caput succedaneum is formed at the early stage of labour, the head being in the first position, its centre is near the border of the anterior parietal bone near the centre of the sagittal suture (1·4, Fig. 95). The reason why it is not centrally situated over the sagittal suture, even though there be no lateral obliquity of the head, is because the anterior part of the os uteri, looking toward the yet imperfectly dilated vagina, is less supported than the posterior. As the head becomes more flexed in advancing, the centre of the caput succedaneum (in occipito-anterior positions) gradually advances nearer to the posterior fontanelle. It is in this later stage of labour that the most marked caput succedaneum is generally formed, and it may then project an inch or more from the level of the cranial bones. In Fig. 95, 1·4, 1·4*b*, 1·4*b* show the successive positions in the first position of the head, or fourth position after rotation, 2·3, 2·3*b*, 2·3*b* in the second position, or third position after rotation. The same points will be approximately the successive presenting points of the head in the two positions, if, with Matthews Duncan, we define the presenting point

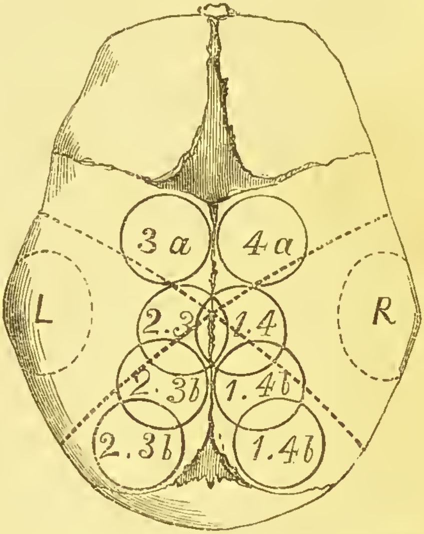

Fig. 95.—Diagram showing positions of centre of caput succedaneum in the several positions of the vertex.

1·4, 1·4*b*, 1·4*b*. Successive positions of centre of caput succedaneum in first position of the vertex, and in fourth position after rotation.

2·3, 2·3*b*, 2·3*b*. Successive positions of centre of caput succedaneum in second position of vertex, and in third position after rotation.

3*a*. Position of centre of caput succedaneum in unreduced third position of vertex.

4*a*. Position of centre of caput succedaneum in unreduced fourth position of vertex. (After Tyler Smith.)

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* "On the Varieties of Form imparted to the Fœtal Head," Obst. Trans., Vol. VII.

† "Lehrbuch der Geburtshülfe," p. 150.

as that point on the surface of the head through which the curved axis of the developed genital canal passes. If, however, we take Tyler Smith's definition, which seems a preferable one, that the presenting point is that point of the head which is most centrally situated in the os uteri, the vagina, and the ostium vaginæ in the successive stages of labour, then in the first stage, before full dilatation of the os, the presenting point will be a point on the sagittal suture, provided that the os is central in reference to the axis of the brim, and there is no Naegele-obliquity of the head.

In unreduced occipito-posterior positions the centre of the caput succedaneum advances forward toward the anterior fontanelle as the head descends, instead of approximating to the posterior fontanelle. Thus in some cases the anterior fontanelle may be almost in the midst of the caput succedaneum. In Fig. 95, 1·4, 4*a* indicate the successive positions in the fourth position of the head, 2·3, 3*a* in the third position.

The position of the caput succedaneum will, after the birth of the child, in many cases show in what position the head has been delivered. Both the size of the caput succedaneum and the extent of the moulding of the cranium depend upon the amount of pressure to which the head has been subjected, in conjunction with the duration of labour.

The caput succedaneum is formed by effusion of serum in the cellular tissue, with occasionally slight extravasations of blood at various points. It is at its maximum at the time of delivery, and progressively diminishes from that time. Its diagnosis from cephalhæmatoma, formed by rupture of a considerable vessel, will be considered under the head of that affection.

DIAGNOSIS OF CRANIAL POSITIONS.

(1.) **By abdominal palpation.**—Much information as to the position of the fœtus may be obtained by examining the abdomen, and this method of examination should always be practised in any case in which the presentation and position are not at once obvious on vaginal examination. The patient should be placed in the dorsal position, and the examination should be made in the absence of a pain. The general shape of the uterine tumour will indicate whether the child is lying longitudinally or transversely in relation to the axis of the uterus. In pelvic presentations the round hard mass of the head can generally be made out at the upper part of the uterus, and the absence of such a mass, if the position of the child is ascertained to be longitudinal, indicates head presentation. The next point is to determine toward which side the back of the child looks. Generally, toward one side of the abdomen the firm uniform mass of the back, without any marked projections can be detected, while on the other side the limbs are felt, especially the knees or feet. These will be moveable in the liquor amnii, if the membranes are still unruptured, and may be making active motions. The position where the fœtal heart is best heard will give confirmatory evidence, for this position is on the side toward which the back is directed, except in the case of face presentation.

(2.) **By vaginal examination.**—Even before rupture of the membranes, or dilatation of the os, the round mass of the head, and its separation from the body at the neck, can generally be made out on bimanual examination between the internal and external hand through the uterine wall, the patient being placed in the dorsal position. Examination through the os uteri, to determine the presentation and position, must be made in the interval of pains, while the membranes are lax. The head is distinguished by its hardness and uniform outline. Sometimes the yielding portions of the bones, on being impressed with the tip of the finger, bend under the pressure with a parchment-like crackle, which can be both felt and heard. After the rupture of the membranes, the accoucheur may often arrive at immediate certainty that the head is presenting by feeling the hair on the scalp.

The sutures and fontanelles can generally be made out before rupture of the membranes, but more easily after the liquor amnii has escaped, and when the head is no longer covered by the membranes. While the os is still small, it is probable that all which can be detected will be a single suture, the sagittal, crossing it generally in the right oblique diameter, approximating nearer to the transverse than the antero-posterior. This will prove that the head lies either in the first or third position, and if the direction of the back is made out by abdominal examination, it is easy to decide which of these two the position is. Similarly, if there is a suture running in the left oblique diameter, the head must be in the second or fourth position. The fontanelles at this early stage will probably be about equidistant from the centre of the os, covered by the uterine wall. The anterior is distinguished by its large size, and the four sutures at right angles meeting in it; the posterior by its small size, not forming any actual space, and the three sutures meeting in it. If either fontanelle or both can be reached, the position of the head is determined by vaginal examination alone. The direction of the posterior fontanelle will, of course, give the direction of the occiput.

When the os is more dilated, and the head has descended lower and become flexed (in occipito-anterior positions), the posterior fontanelle is generally reached easily, while the anterior is reached with more difficulty, by tracing the sagittal suture (see Fig. 53, p. 89). This change in the facility of reaching the two fontanelles results from the internal rotation of the head, when that has progressed, even though there should be no increase of flexion. In cases of somewhat difficult labour, when flexion is very great, and the head large and much elongated, the posterior fontanelle may become very nearly the presenting point. The fontanelle may also be obscured by being nearly in the centre of the caput succedaneum. Nothing is then readily made out except the three converging sutures. When the case is seen for the first time at this stage, the diagnosis of the position of the head is not quite so easy, from the difficulty of telling which is the occipital bone. The anterior fontanelle may be reached by passing, if necessary, half the hand into the vagina—the left hand, if the patient is lying in the usual left lateral position. In some cases also the anterior ear can be reached without much difficulty, especially when Naegele-obliquity exists. There is, however, a simple and easy mode of determining the point, depending upon the laws of the moulding of the head, according to which the occipital always passes beneath the parietal bones. If it can be ascertained that one of the three bones has a tendency to become depressed beneath the other two, that bone is certainly the occipital bone, and the direction of the occiput is thus determined.

Again, in occipito-posterior positions, as the head descends in the pelvis, the anterior fontanelle may be nearly in the centre of the presenting part, and the posterior fontanelle may be difficult to reach. Then, in a similar way, if it can be ascertained that two of the bones tend to be depressed under the other two, these are determined as being the two segments of the frontal bone, and the position of the head is thus known.

A criterion is given for distinguishing occipito-posterior from occipito-anterior positions even before the opening of the os. This is that, in occipito-posterior positions, the anterior segment of the uterine wall as felt from the vagina does not descend so low behind the pubes as in occipito-anterior, because the forehead does not generally lie so deeply as the occiput in reference to the plane of the brim. This criterion is not, however, always decisive, since, in occipito-posterior positions, the forehead often lies lower than usual in comparison with the occiput.

The third stage.—After the expulsion of the child, the woman generally has a feeling of intense relief and comfort, after the agony and exertion she has gone through. More rarely she may feel exhausted or faint, or a rigor may occur.

The natural course of the third stage of labour, or expulsion of the placenta, is rarely seen, since it is usually shortened by art. It appears that, in general, the placenta is detached, partially at any rate, almost immediately after the birth of the child. For, in a multipara, and where there is no obvious laceration of perineum or vagina, the first appearance of blood commonly indicates that some separation of placenta has occurred. Such appearance of blood may usually be noticed very quickly after the expulsion of the child. Moreover, Lemser examined with the entire hand in 168 cases immediately after the birth of the child. He found that in 71 per cent. the lower edge of the placenta could be felt lying in the os uteri directly the hand was introduced, and in 94 per cent. within nine seconds after delivery of the fœtus. On the other hand, in the uterus removed by Porro's operation, the placenta is, in most cases, found completely attached. The vigour of the contraction and retraction of the uterus must, however, be impaired by the incision in the anterior wall, as well as by the effect of the anæsthetic given to full surgical degree. The Porro uterus cannot therefore be assumed to represent the normal condition.

Mechanism of detachment.—There has been much controversy as to the mechanism both of the detachment and the expulsion of the placenta, and the matter is not yet fully settled. One cause is almost universally acknowledged to be a valid one, and by some is regarded as being the only one, namely the shrinking of the placental site in the retraction of the uterus. On this subject some facts may be deduced from mechanical considerations. For, consider the condition of the placenta when shrinking of the placental site has occurred a little short of that necessary to cause detachment. First, suppose the form of the uterus globular; the effect of shrinking will then be independent of any detrusion. Any section through the uterine wall and the placenta will form an arc of a circle; and detrusion cannot commence until the placenta has been separated. The uterine surface of the placenta will be compressed towards the centre of its area, owing to its attachment to the shrunken placental site. This compression toward the centre will decrease from the uterine to the fœtal surface, which is free. Hence any small element of area on the uterine surface of the placenta, at the centre will be subject to no radial tension. Any other small element of area will be subject to radial tension because it will be drawn toward the centre by its attachment to the uterine wall, and drawn outward by its connection with the corresponding areas of the substance and fœtal surface of the placenta, which have not been drawn so much inward toward the centre,

Shrinking
placental
site

At the same time the shrinking of the placental site will be resisted by the attached placenta, and will therefore be less than that of a corresponding area elsewhere in the uterus. The radial tension will increase from the centre toward the circumference, because the obliquity of lines joining corresponding areas of uterine and fœtal surfaces will increase, the fœtal surface being less drawn in toward the centre than the uterine. Moreover, while any element of area away from the border is supported on all sides by other elements of area, an element of area on the border is unsupported on the outside. For both reasons, separation must begin at the circumference, and spread inward toward the centre, unless the placenta is more firmly adherent at the circumference than at other parts, and there is no evidence that it is so as a general rule. This reasoning is in accordance with the result of experiments made by sticking a disc to an elastic surface, and then letting the surface retract.

The mechanism is somewhat modified if the retracted uterus is not globular, but tends to adopt its natural form of a flattened pear-shape. This it does in the Porro uterus, and probably also in normal conditions, to some extent at any rate. In this case, if the placenta is situated on the anterior or posterior wall, reaching to the sides and summit of the uterus in its retracted shape, the sides may be so pressed inward by the uterine contraction as to do away with the outward radial tensions in a lateral direction. Similarly the top of the placenta may be so pressed down by the fundus uteri as to do away with the upward radial tensions in its upper half. But if so, the placenta having been already compressed as much as it can be, the same force will be transmitted to the lower half, and will there increase all the downward radial tensions, so that separation will commence at the lower border, from the effect of detrusion in addition to retraction. There can be nothing in the contraction of the uterus in any case to diminish the downward radial tensions. If on the other hand detrusion acts, when the placenta has not been compressed to the maximum degree or nearly so, the downward pressure may separate the top of the placenta first, the placenta not being able to transmit the force like a rigid body to its lower margin. It appears probable, therefore, that shrinking of the placental site and detrusion are the main forces concerned in the detachment of the placenta, and that in most cases separation commences at the lower margin. This is rather confirmed by the condition of a uterus which I removed by Porro's operation.* The placenta is there separated at the lower edge only, but elsewhere adherent. Any morbid adhesion at any part of placenta would of course modify the commencement of separation.

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* See Obstet. Trans. Vol. XXIX., for full description.

(2) Retro placental hæmatoma
(3) Diminution of intra uterine pressure

When separation has once commenced, some blood is poured out, in the interval of pains, between the separated surfaces, and must tend to aid the further separation, if the membranes are still sufficiently attached to prevent its flowing away at the sides. Some have considered the formation of this retro-placental hæmatoma to be the main cause of separation. Matthews Duncan, on the other hand, considered that it had no place in the normal mechanism. Probably it comes into play in many or most cases, but as a subordinate cause. Some have attached importance to the diminution of intra-uterine pressure after delivery. The firmly adherent placenta of the Porro uterus appears to disprove this as a cause.

Mechanism of expulsion.—It was formerly thought that the placenta came down like an inverted umbrella, with its fœtal surface near the insertion of the funis foremost, as shown in Fig. 97, p. 200. This necessarily implies that the placenta and upper part of bag of membranes are first inverted by a considerable effusion of blood behind them, and that the uterus afterwards contracts on this effusion of blood, and drives out the placenta by its means (see Fig. 97). According to Matthews Duncan, however, the normal process is that the placenta is folded or rolled together by the contracting uterus on an axis corresponding to the long axis of the uterus, and that it presents at the os uteri by a point on its fœtal surface very near its lower margin, the lower margin having been somewhat inverted by the traction of the membranes which the placenta has to drag after it. As it passes through the vagina, the placenta usually becomes further inverted by the traction of the membranes, which have still partially to be peeled off the uterine wall, and drawn out of the uterine cavity. When, however, the uterus acts well, and the vagina is contractile, the placenta may present even at the vulva by a point on or near its edge, and come out rolled on a longitudinal axis, with its uterine surface outermost. In this mode of expulsion, effusion of blood behind placenta and membranes is not necessary to the mechanism, and Matthews Duncan regarded the ideally perfect expulsion as almost unaccompanied by blood.

More recently, other authorities have advocated the correctness of the old view. The point is of practical importance, because the modern principle that traction should never be made upon the cord is mainly based upon the idea that such traction interferes with the normal mechanism of delivery. There is no doubt that, if traction is made, the placenta is drawn down in the shape shown in Fig. 97.

Champneys,* in 70 cases, marked the spot on the placenta which first presented at the os uteri. In the great majority of cases (all but 10) this spot was on the fœtal surface within two inches from the lower edge. In 16 cases it was on the lower edge, or amnion below the lower edge; in 23 cases it was on the placenta within one inch of the lower edge. In two cases only the uterine surface of the placenta presented. It was found also that the presenting part varied with the position of the placenta. The higher the placenta, the higher the presenting point, and *vice versâ.*

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* "Mechanism of the Third Stage of Labour," Obstet. Trans., Vol. XXIX.

These results indicate a partial and progressive inversion of the placenta and membranes, and a mode of delivery intermediate

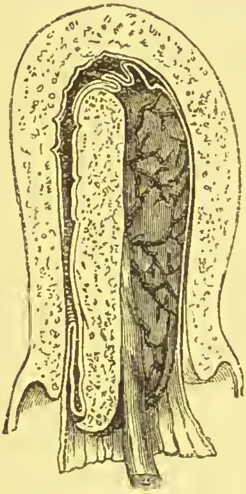

Fig. 96.—Delivery of placenta according to Matthews Duncan.

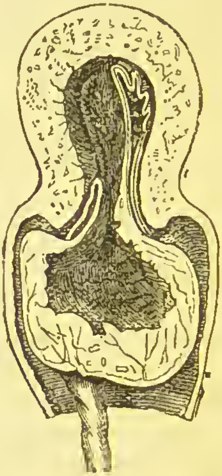

Fig. 97.—Delivery of placenta according to Schultze.

between that described by Schultze and that described by Matthews Duncan. In Champneys' cases, however, the woman lay on her side, and no stimulation was used to the uterus during the third stage of labour. It is probable that the mechanism is not ideally perfect under these circumstances. So far as can be inferred from the customs which exist among savage tribes, the primary position for labour is not that of lying, but rather squatting as for defecation. The delivery of the placenta is assisted by pressure by the woman's own hands, or by the aid of her friends, and she may even stand up to squeeze the abdomen in the third stage of labour. At any rate, the frequency with which the intervention of the accoucheur is called for in the third stage shows that, under our present civilised conditions, its mechanism is often not entirely natural.

My own observations, in cases in which the uterus is stimulated in the usual way by the hand after delivery of the child, lead me to support Matthews Duncan's view so far as to say that the main folding of the placenta, when it passes the os uteri, is generally on a longitudinal axis, though the presenting point is often further from the edge than is represented in Fig. 96. It is easily shown by experiments that the placenta will pass through a much smaller ring when thus folded than when the insertion of the funis comes first.

It is obvious that, the more the expulsion is effected by effusion of blood, the more nearly the mechanism approximates to Schultze's view; the more it is due to uterine contraction, the more nearly it approximates to Matthews Duncan's view. It will generally be agreed that the latter is preferable. The conclusion is that the usual mode of expulsion is intermediate, to a variable extent, between the two mechanisms; but approaches rather to that described by Matthews Duncan, and the more nearly so, the more judicious is the management of the third stage, and the more vigorous the uterine action.

Separation and expulsion of membranes.—It has already been explained (see p. 153) that the membranes are separated from the lower segment of the uterus by its dilatation to form a canal for the fœtus, and that this separation is necessary for the formation of the bulging bag of membranes. By the retraction of the uterus, after delivery, the chorion is partially but not entirely detached, the line of separation passing through the ampullary layer of the decidua (see p. 57), so that the superficial layer of the decidua comes away with the chorion. The chorion is thrown into fine wrinkles, being detached along the ridges of the wrinkles, but remaining attached along the furrows. When the placenta is detached, the blood which escapes thereupon tends to detach also the membranes in the vicinity of the placenta. It does not, however, separate the whole bag of membranes, partly because its quantity is insufficient, partly because it begins to escape externally as soon as it has cleared a way for itself to the os uteri. Then, when the placenta is expelled by the contraction of the uterus, it drags after it the membranes, completing their separation from above downwards, and usually inverting the bag of membranes. When there is sufficient effusion of blood behind the placenta to invert it, as in Fig. 97, this blood, driven down by the uterus, aids in the inversion, detachment, and expulsion of the bag of membranes. By the time the placenta and membranes escape from the vulva the membranes are inverted, the fœtal surface of the amnion being external, and the placenta is often inverted also. If delivery of the placenta is aided by gentle traction on the edge which presents in the vagina, it generally comes down with the uterine surface outermost.

The large arteries and veins passing to the placenta are of course torn across as soon as detachment occurs, and some bleeding takes place from their open mouths. This is the source of the retro-placental hæmatoma, when such is produced. But, unless there is uterine inertia, the open mouths are quickly closed by further retraction of the placental site, the muscular fibres of the middle coat of the uterus interlacing irregularly around the vessels. After a time, the exact duration of which is unknown, permanent closure is secured by the formation of thrombi in the vessels beyond the constricted part, just as thrombi are formed in any other vessels the current through which is arrested by pressure or ligature. Champneys estimates the amount of blood escaping as six ounces before the delivery of the placenta, and six ounces enclosed in the placenta and membranes. As in his observations the uterus was unstimulated during the third stage of labour, the woman lying on her left side, the average quantity, when the uterus contracts well, is probably less.

Occasionally the placenta is expelled into the vagina, or even externally, by the same pain which expels the fœtus. More frequently there is a rest for a variable time—perhaps for from twenty minutes to an hour, or even longer, in the absence of external stimulus. During this time the uterus may be felt moderately hard, and still reaching up to some height in the abdomen, generally about up to the umbilicus. At this period, as well as at other times, rhythmic contractions, though not very marked, take place in addition to the tonic contraction, and therefore the uterus varies in hardness. After a time the contractions again become stronger, and are felt as pains, although slight as compared with those of the expulsive stage. With these pains a little blood may be expelled, and hence they have been called "dolores cruenti." They have the effect of gradually completing the detachment of the placenta, if that is not completed just after the birth of the child, or by subsequent effusion of blood behind the placenta, and at length of expelling it from the body of the uterus in the manner already described, so that it lies partly in the flaccid relaxed cervix and partly in the vagina. Its expulsion externally, in the absence of assistance, is effected by the expiratory muscles, aided by the muscular walls of the vagina and cervix.

After delivery of the placenta, the uterus may be felt in the hypogastrium as a comparatively small firm ball, varying, however, considerably in size in different women. The average level of the fundus may be taken as about five inches above the pubes, and more than half-way from pubes toward umbilicus; but, when the uterus is large or rests unusually high above the pelvis, it may reach even up to the umbilicus. Rhythmic contractions, in addition to the tonic contraction, continue to take place in it, although not necessarily felt by the woman as pains. In all cases, therefore, it varies in hardness, and this variation must not be considered as indicating a risk of hæmorrhage, unless either the relaxation is too great in the intervals, or gushes of blood take place with the contractions, or between them.

Duration of labour.—Very wide differences are found between the duration of labour in different women, depending partly upon the vigour of the expulsive forces, partly upon the relation between the size of the fœtus and the canal of the bony pelvis and the soft parts, as well as upon the dilatability of these latter. The first stage generally occupies at least three or four times as long as the second, and in multiparæ the second stage may be completed by a very few pains. In primiparæ the length both of the first and of the second stage is very much greater: that of the first from the greater rigidity of the cervix; that of the expulsive stage, from the resistance offered first by the orifice of the vagina, formed by the ring of hymen so far as it still exists, which must inevitably be more or less lacerated; and secondly, by the perineum, which has never before undergone dilatation.

The average duration of labour, reckoning from the first manifest pains, may be taken as being about fifteen hours in primiparæ, and seven or eight hours in multiparæ. In primiparæ beyond the age of thirty-five years, the duration of labour is greater, and, on an average, exceeds twenty-four hours.

A greater number of labours take place during the night than during the day; the hours during which most commence being those from 9 to 12 P.M., and those during which most are terminated those from midnight to 3 A.M.

CHAPTER XIII.

MANAGEMENT OF NORMAL LABOUR.

It is a well-known rule that the accoucheur should always attend promptly to the first summons from a lying-in woman. It may be that she has deferred sending till the last moment, or labour may be extremely rapid. In such a case, if from any delay of the attendant the child is born before his arrival, the mother's life may be lost from post-partum hæmorrhage, or the child's in a case of pelvic presentation. Again the favourable moment for interference in a case of abnormal presentation may be lost. If, on the other hand the patient has sent unnecessarily early, the attendant, after ascertaining the exact state of affairs, and the probable duration of the labour, may confidently leave her for a time.

Requisites to be taken by the accoucheur.—The attendant should be provided with a stethoscope, a catheter (either a silver female catheter or a No. 10 or No. 12 gum-elastic male catheter), bottles containing chloroform, sulphuric ether, solution of chloral, tincture of opium or Battley's liquor opii sedativus, liquid extract of ergot, or liquor secalis ammoniatus, or some liquid preparation of ergotin, blunt-pointed scissors, a Higginson's syringe, which may with advantage be provided with a long vulcanite tube for intra-uterine injection, a hypodermic syringe, a chloroform inhaler, and either a small elastic catheter (No. 6), suitable for passing into the infant's larynx, or a tube specially made for that purpose. These may be carried in a simple leather bag with pockets at the sides for the bottles. There should also be in the bag suitable needles and sutures (silk-worm gut or silver wire) for stitching the perineum, and either iodoform gauze for plugging the uterus, or some preparation of perchloride of iron, either the liquor ferri perchloridi fortior, or the solid salt. The latter is somewhat less likely to rust the iron instruments in the bag; but even for this it is well to have a bottle with a cap over the stopper. A pair of forceps may also be carried in the bag, especially if the accoucheur is going far from home. These or any other obstetric instruments are most conveniently carried wrapped separately in chamois leather, which may be secured by indiarubber rings. There should be provided in the room hot and cold water, thread for tying the funis, an abdominal binder, and a supply of diapers.

Certain antiseptics must either be carried in the obstetric bag, or provided beforehand at the house. These are perchloride or iodide of mercury for disinfection of hands and non-metallic instruments, and either carbolic acid, lysol, or permanganate of potash for metallic instruments; of these two, the two former are the more effective. Perchloride of mercury may be carried either in tabloids or in solution. If tabloids are used they should be tested with the water of the district in dilute solution, to make sure that no precipitate is formed by the hardness of the water. They should contain no powdery colouring matter, which would mask the slight milkiness caused by precipitation. I prefer to carry a concentrated solution according to the following formula:—R. Hydrarg. Perchlor. gr. xx., Acid: Hydrochlor. dil. ʒss., Glycerini ʒi., Aq. ad ℥i. The acid increases the efficacy of the mercury in the presence of albuminous matter. A concentrated solution of mercuric iodide may be made according to the following formula:—R. Hydrarg. Iodid. Rubr. gr. xx., Potass. Iodid. gr. xv., Aq. ℥i. Pure carbolic acid may be carried, liquefied by 10 per cent. of water; permanganate of potash may be carried in crystals.

Antiseptic precautions.—The reports of the Registrar-General show that the mortality due to puerperal septicæmia throughout Great Britain considerably exceeds that due to all the difficulties and accidents of labour. Hence the most important thing of all, in the conduct of normal labour, is to take precautions against the occurrence of septicæmia. Of late years, by the improvement of antiseptic measures, and especially by the use of perchloride of mercury as an antiseptic, lying-in hospitals have been converted from the most dangerous places of all for delivery into the safest. There is therefore strong reason for believing that a universal adoption of stringent antiseptic precautions would considerably diminish the present mortality from puerperal septicæmia.

I may so far here anticipate the subject of puerperal fever as to state the following facts. It is excessively difficult absolutely to sterilise the vagina by any antiseptic treatment, but the microbes or germs ordinarily present in it do no harm unless substances capable of decomposition, such as placenta, are retained. On the other hand, if virulent microbes are introduced, such as may be carried especially from puerperal or any other form of septicæmia, or from phlegmonous erysipelas, they may cause fatal septicæmia after perfectly normal labour. The most important element of antisepsis therefore consists in preventing the introduction of virulent germs into the genital canal, and this can be done without the risk of injurious effects which may attend the injection of poisonous antiseptics.

The use of antiseptics does not supersede but supplements ordinary cleanliness. Both accoucheur and nurse should keep nails cut short and wash thoroughly with soap and water and a nail-brush before touching the genitals. The hands should then be disinfected by thorough immersion in a solution of perchloride of mercury 1 in 1,000. A basin of the same solution should be kept by the bedside, that the hand may again be dipped in from time to time. The nurse must use the same precautions before each washing of the genitals after labour; and the same solution must also be used to disinfect a catheter, if one is required. If a solution of 1 in 1,000 is found to roughen the hands too much, one of 1 in 2,000 may be used. Forceps and other steel instruments, after thorough cleansing, are best disinfected by a solution of lysol 1 in 50 or of carbolic acid of a strength of at least 1 in 40. It must be remembered that soap is incompatible with most antiseptics, except carbolic acid, and destroys their efficacy; also that a very small quantity of carbolic acid precipitates the sublimate solution. Lysol, being alkaline, has in itself a considerable cleansing as well as antiseptic power, and may be used, with advantage, for the hands, before their immersion in mercurial solution. Iodide of mercury may be used instead of the perchloride, and is even more efficacious, though somewhat more expensive.

Opinions differ about the use of antiseptic douches before or immediately after labour. In private practice they are at any rate of less essential importance than the preventing the conveyance by accoucheur or nurse of virulent germs. The external genitals should be washed by the nurse with soap and water at the outset of labour. If there is an opportunity for doing so at an early stage of labour, it appears to be desirable to douche the vagina once, by means of an irrigator, with a solution of perchloride or iodide of mercury 1 in 2,000. At a more advanced stage of labour this proceeding has the disadvantage that it washes away the abundant lubricating secretion which is then naturally poured out. If the mercurial douche has not been used before delivery, a single douche may be given immediately after delivery of perchloride or iodide of mercury, 1 in 4,000, at a temperature of 105°—110° F.; or the solution may be used first of a strength of 1 in 2,000, and then washed away with the weaker mercurial solution. The occasional appearance of poisonous symptoms after the use of mercury has generally followed the repeated use of the solution rather than a single douche. But it must be remembered that immediately after delivery is the time when there is the greatest possible extent of absorbent surface. If, therefore, a mercurial douche is used at that time, special care must be taken to ensure that it flows freely away, and that no excess of it remains in the vagina or cervix.

Another antiseptic precaution is to thoroughly clear out the rectum at the commencement of labour, and so avoid the extrusion of fæces by the pressure of the advancing head. This is best carried out by the administration of a copious enema when pains commence. But if there is any tendency to constipation, a daily action of the bowels should be secured by an aperient at the time when labour is expected.

It is a matter of dispute whether sewer-gas can actually originate puerperal septicæmia. At any rate, it may be a predisposing cause, by depressing the health of the patient. Care should therefore be taken beforehand that the drains of the house are in good order, and that there is no concealed water-closet in bedroom or dressing-room, nor any untrapped waste-pipe in or near the rooms.

The antiseptic precautions required during the puerperal period will be considered later, and the special precautions necessary in lying-in hospitals will be discussed under the head of puerperal septicæmia.

Preliminary preparations.—The room should be as airy as possible and also quiet. The bed should be firm, and a feather bed is especially to be avoided. The bedding should be protected by a waterproof sheet, and a draw-sheet, folded in several thicknesses, should be placed under the hips, so that it can be readily removed when soiled. Special lying-in sheets are made, stuffed with sublimate wood-wool. These have the advantage over the simple draw-sheet, since they are capable of absorbing a considerable quantity o liquor amnii or other discharge. With the lower classes it is usual to wear till the labour is completed an old suit of the ordinary dress, including stays, which often prove inconvenient. It is preferable for the patient to be in her night-dress, over which she may wear a dressing-gown in the earlier stages of labour. It is a good plan for her also to wear underneath the night-dress a special petticoat, fastened loosely round the waist. The night-dress can then be tucked up and kept clean during delivery, and, when the labour is over, the soiled petticoat can be easily slipped off, and the necessity for changing the night-dress avoided. With the poorer classes the attendant should insist that no more persons than necessary are in the room, since, especially among the Irish, the neighbours are fond of gathering in the lying-in room.

Position of the patient.—In this country it is usual for the woman to lie on her left side, with the hips brought near the edge of the bed, during the latter stage of labour, or for an examination. On the Continent and in America the dorsal position is the usual one. Each position has its own advantages, but on the whole those of the lateral position predominate. In point of delicacy it has the superiority ; it allows forceps or other instruments to be used with less exposure and less disturbance to the patient ; and it tends to correct the common right obliquity of the uterus. Moreover, during the passage of the head over the perineum, the pressure on the perineum is not increased by the weight of the child, as it is in the dorsal position, and hence the risk of laceration is somewhat less in the lateral position. On the other hand, the dorsal position tends somewhat to accelerate labour during the earlier part of the passage of the head through the pelvis. Not only does the weight of the child give direct assistance to the expulsive force, but, by pressing the presenting part more firmly upon the os uteri or vagina, it stimulates the contractions of the uterus in a reflex manner. This is especially useful in cases of uterine inertia.

Examination of the patient.—The first object is to ascertain whether the presentation and the maternal passages are normal. The entrance of the accoucheur, however, is apt to put a stop to the pains for a time, and he should, therefore, be careful to avoid startling the nerves of the patient. It is well to sit down quietly for a while, ask a few questions about the time when the pains commence, their frequency, character, and situation, whether any "show" has been seen, whether the waters have broken, whether the bowels have acted freely, and also to feel the patient's pulse. He should also inquire (if he has not previously ascertained) about the character of former labours, the state of health during pregnancy, and whether the patient has reached the full term. He should see that his hands are warm before making any examination. For this purpose the antiseptic solution for disinfecting hands should be used hot.

It is desirable to make an abdominal examination in order to ascertain by palpation whether the uterus and fœtus are naturally placed, and also to make sure, either by feeling movements or hearing the fœtal heart, that the fœtus is alive. Abdominal examination is more troublesome than vaginal when the ordinary dress is worn, but the student should be careful to use all opportunities both of practising auscultation of the fœtal heart and acquiring skill in making out the parts of the fœtus and its position by abdominal palpation. He should not scruple, therefore, to have the stays removed if they are worn.

It is usual and preferable to commence the examination during a pain, and hence arises the common phrase of "taking a pain." Her attention being distracted by the pain, the patient does not notice so much the inconvenience of the introduction of the examining finger. The index finger of the right hand, anointed with an antiseptic lubricant, such as lanocreolin, or glycerine containing perchloride of mercury 1 in 1,000, is generally used for examination in the position shown in Fig. 98. The inexperienced student may pass the hand up the back of the thighs to the buttocks, and then find the perineum and fourchette as a guide to the entrance of the vagina.

The condition of the vagina may first be noted, especially as to its freedom from any obstruction or contraction, the relaxation of the mucous membrane, and the amount of lubricating secretion present. An abundant secretion of slimy mucus is generally a safe indication that labour has set in in earnest, and that the pains and dilatation of the os will progress in a satisfactory manner. For the physiological relaxation of the cervix, generally associated with good expulsive pains, is usually attended also by a copious secretion from the cervical glands, which are greatly under the influence of the nervous system.

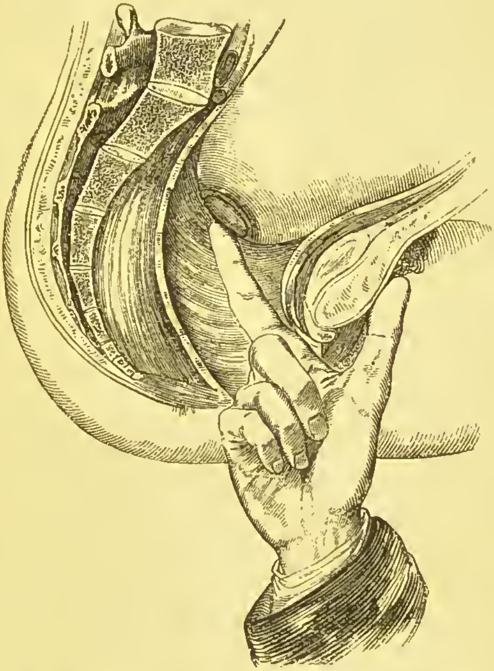

Fig. 98.—Examination in the stage of dilatation.

The next point is to make out the size of the os uteri, and the condition of its edges. The inexperienced student must be careful definitely to feel its margin, and not to overlook a very small os, and mistake a thin uterine wall stretched over the presenting part for the bag of membranes. If the os is still small, it may lie so far back in the hollow sacrum as to be difficult to reach. In such a case the accoucheur should see that the bladder is empty, since a full bladder displaces the cervix much further back, and should place the patient on her back, introducing two fingers of the right hand into the vagina, and pressing the fundus downward and backward with the left hand placed on the abdomen. Another plan, but not such a good one, is to place the patient transversely on the bed, still lying on her left side, and introduce two fingers of the left hand into the vagina, the flexor surfaces directed toward the anterior pelvic wall. Examination while the pain still continues will best reveal the condition of the os, and the effect of the pain upon the os, the bag of membranes, and the presenting part. A thin hard margin to the os generally denotes that dilatation will be slow ; if the edge is soft and thick, it is likely to yield much more quickly.

To make out the presenting part, if the membranes are still intact, it is necessary to continue the examination during the interval between the pains. No attempt to explore it should be made while the bag of membranes is tense, lest the membranes should be ruptured prematurely. If the os is still small it is sufficient for the accoucheur to satisfy himself that the head is presenting, without making out its exact position by feeling the fontanelles. To do this, however, it is not sufficient to feel the presenting part through the uterine wall, but the finger must be passed in through the os to touch it. If, on passing the external os, the finger finds a cervical canal still existing, so that the bag of membranes or presenting part does not rest upon the external os, but only upon the internal os, or upper orifice of the canal, it is generally a sign that the labour will not soon be over. For the internal os and cervical canal have to be dilated before dilatation of the external os begins, and this process is indeed often completed during the few days before active labour, while there are still no well-marked pains.

If a bag of membranes only is felt, and no presenting part can be reached, special care is necessary to ascertain whether there is any abnormal presentation, especially a shoulder presentation or transverse position of the child. In this investigation, examination of the abdomen should on no account be omitted. In some cases the failure to feel any presenting part may arise simply from the liquor amnii being very abundant, and the head resting far forward above the symphysis pubis. In such a case the head may be reached by pressing the finger far forward within the os, while the patient lies on her back, and the external hand presses the head down from above. If one or two fingers fail to reach any presenting part, the dilatation of the os having made some progress, the half hand or whole hand should be introduced into the vagina for the purpose, an anæsthetic being given, if necessary.

If the presenting part has not descended into the pelvis when the first examination is made, and particularly if no guidance is to be obtained from the history of previous labours, the size of the pelvis should be explored by the finger. More especially, the accoucheur should test whether the promontory of the sacrum can be reached too easily, and, if it can, he should measure the diagonal conjugate diameter (see Chapter XXIX.). He should also judge whether there is less space than usual on either or both sides of the pelvis, and note also the size of the cavity and outlet. Next, it is well to examine whether any fæces can be felt in the rectum; and if any are found, to have an enema administered, if labour is not too far advanced, or too rapidly advancing. A collection of fæces in the rectum may materially delay the progress of labour before it is expelled before the advancing head. Even a small quantity of fæces interferes with perfect antisepsis.

As to the probable duration of labour, the medical attendant may form an opinion for his own guidance from the size and dilatability of the os, the amount of mucus present, and the size of the pelvis. He should avoid risking his credit by making any positive prophecy as to time to the patient or her friends, but should content himself with assuring her that all is going well, and that the duration of labour will depend upon the pains. As to whether or not it is necessary for him to remain continuously in attendance, he will judge partly by the state of the os, partly by the vigour and frequency of the pains, taking also into account whether the patient is primipara or multipara. In any case of doubt, he should wait for at least half an hour or an hour, to watch the rate of progress. Sometimes a patient may send for her attendant when suffering only from false pains, that is to say, irregular and painful contractions of the uterus, which do not dilate the os. False pains generally recur at very irregular intervals, not with the more or less rhythmic regularity of true pains. But we can positively distinguish them only by making a vaginal examination, and finding that they do not produce dilatation of the os, or cause protrusion of the bag of membranes. False pains commonly depend on some irritation in the alimentary canal, and are best treated by a mild aperient combined with a sedative, such as hyoscyamus.

Management of the first stage.—During the first stage the patient should not be kept too much in one position. It is generally better that she should be up, occasionally walking about, and occasionally resting in a chair. If the first stage is tedious, the lateral position is especially to be avoided, because, in that position the weight of the ovum is taken off from the os and cervix, and the reflex stimulus is thereby diminished. If she lies down, the patient should rather lie on her back. At this stage, she should be enjoined not to weary herself with bearing-down efforts, which at present are useless, and her strength should be kept up by a sufficient amount of light nourishment. With the lower classes it is often necessary to discourage the use of alcohol. During the dilatation stage examinations should not be made too frequently, but only sufficiently often to observe what progress is being made. More especially before the stage is reached at which the abundant secretion of mucus begins, frequent examination is apt to irritate the cervix and vagina, and increase the dryness of the canal. On the rupture of the membranes, an examination should always be made, because the presentation may be changed with the gush of liquor amnii, or the funis may become prolapsed.

If the attendant remains during a prolonged first stage, he should remember not to remain too continuously in the room, but give the patient opportunities to empty her bladder. Occasionally difficulty of micturition arises from the pressure of the head on the neck of the bladder or urethra, and the use of the catheter may be necessary. A distended bladder may be a cause of prolongation of labour, from its interfering with the effective action of the auxiliary muscles. With the elongation of the cervix and distensible lower segment of the uterus, the upper part of the bladder is carried upward above the level of the pubes (see Fig. 72, p. 155). Hence, if an abdominal examination be made, the bladder, if at all distended, is readily felt as an elastic rounded swelling in front of the lower portion of the uterus. For emptying the bladder a full-sized male gum elastic catheter (No. 10 or No. 12) is generally preferable to the short silver female catheter, since the urethra may be lengthened and distorted by the displacement of the bladder upwards, and the pressure of the head; and it is not sufficient to reach the flattened lower portion of the bladder in order to evacuate the urine. The swollen meatus is also apt to be displaced further forward than its usual position. Difficulty sometimes arises in getting the point of the catheter past the head. One or two fingers should then be passed into the vagina, and, by pressure forwards through the urethral wall, the point of the catheter should be guided up to and past the point of compression. If necessary, the head should be pushed somewhat backward, in the interval of a pain, to give the catheter room to pass.

Artificial rupture of membranes.—When the dilatation of the os is complete, labour is accelerated by artificial rupture of the membranes (see p. 160). The risk is also by this means averted that the amnion may be separated from the chorion by too far an advance of the bag of membranes in front of the head, and that the chorion may consequently be left behind in utero. The experienced practitioner may often with advantage rupture the membranes rather before the os is fully dilated to the size of the vagina or that of the greatest diameter of the head, but not before it is large enough for the head to enter it sufficiently to form a dilator not less efficient than the bag of membranes. If the membranes are ruptured prematurely, the os is apt to remain rigid, and a labour, which had been progressing favourably up to that point, may pass into an inactive stage. The inexperienced student should rather incline to the alternative of leaving the membranes too long intact than to that of rupturing them too early. The bag of membranes may generally be ruptured by pushing the tip of the forefinger through it when rendered tense by a pain. If the membranes are too tough to allow this, they should be gradually scratched through with the finger nail, while still tense. If this still fails, they may be ruptured by pressing upon them with some pointed instrument. A catheter stylet, or uterine sound, is preferable to the traditional hair-pin, often used for this purpose, and care must be taken to render aseptic whatever instrument is used. Sometimes there may be so little bulging of the bag that it is difficult to judge whether the membranes are ruptured or not. This may be due to scantiness of liquor amnii, or to the membranes being inelastic and remaining adherent near the margin of the os. In such a case the distinction may be made by the contrast of the smooth surface of the membranes with the roughness due to the hair on the scalp. Sometimes, by sweeping round the forefinger an inch or two within the margin of the os, the membranes may be separated, and the bulging bag allowed to form. In rupturing the membranes artificially, especially if liquor amnii appears abundant, it is a good plan to place a bed-pan or bed-bath under the patient, to prevent her getting wetted. Otherwise, the excess of fluid should be mopped up with napkins, and the draw-sheet shifted to a dry place.

Management of the second stage.—Toward the end of the first stage, the patient should lie down in the left lateral position. To aid the expulsive pains, it is usual to tie a round towel to the foot of the bed, so that, by pulling upon it during the pain, the patient may gain some assistance in fixing her chest for the action of the auxiliary muscles. Women often like also to be able to rest their feet against the foot of the bed. As soon as the membranes are ruptured, the exact position of the head should be made out by the sutures and fontanelles, if this has not been done previously, so that, in case of occipito-posterior positions, the management presently to be described may be carried out. During the second stage, examinations should be made much more frequently than before, that the progress of the case may be carefully watched. If pains are vigorous, and advance being made, it is well to examine at each pain. The patient generally derives confidence from the presence of the attendant, and often imagines that she is receiving more assistance than can, in point of fact, be given to nature. In general, women instinctively hold their breath, and bring the auxiliary muscles into action during the expulsive pains. Sometimes, however, especially in the case of sensitive women who feel the pains acutely, their efficacy is diminished by lack of closure of the glottis. In such a case, the woman must be repeatedly exhorted not to cry out in the pain, but to hold her breath and bear down. The giving a little chloroform during the pain, short of anæsthesia, may assist towards this object. The patient need not be kept rigidly in the lateral position. If the uterus is inert during the earlier part of the passage of the head, it is of advantage to place her on her back, and so increase the reflex stimulus due to pressure of the head.

Management of occipito-posterior positions.—If a diagnosis of the position of the head is made in occipito-posterior positions, it is almost always possible to secure by manipulation that rotation of the occiput forwards which fails in about 4 per cent. of the cases left to nature. It has already been explained that failure of rotation is always due to insufficient flexion (see p. 186). Hence the effort should be to promote flexion rather than to attempt the more difficult task of directly rotating the head. This is to be done by pressing up the forehead with one or two fingers *during the pains*, and endeavouring at the same time somewhat to aid its rotation backwards. The physician may also, if he can readily accomplish it, *in the interval of the pains*, hook two fingers over the occiput and draw it downwards and somewhat forwards. Rotation cannot however be expected to occur, and it is therefore useless to attempt to promote it, until the os is sufficiently dilated to allow the occiput to pass over its margin, and meet the resistance of the pelvic floor. The treatment of protracted labour in occipito-posterior positions by the aid of the vectis or forceps will be considered in the chapter on the use of those instruments.

Preservation of the perineum.—When the head begins to press upon the perineum, the physician has a much more important duty to perform than in the earlier stages of its passage; and by skilful management he can do very much to avert laceration, more especially in the case of primiparæ, with whom the risk of such laceration is much greater. The plan formerly recommended was to "support the perineum," that is to say, to press with the palm of the hand upon the perineum when stretched over the advancing head, and so check that advance. It is now generally agreed that such pressure on the perineum is a stimulus to increased uterine action, and so, when pains are violent, may actually bring about the accident which it is desired to avoid. In other cases again, this plan of prolonged pressure led to quite an unnecessary delay in the passage of the head.

The causes which chiefly tend to rupture of the perineum, and which are capable of being modified by art, are two:—first, and chiefly, the head being forced through the outlet by vigorous pains before the perineum has had time to dilate in the natural manner under the influence of repeated pains; secondly, the fact that the uterine force transmitted to the condyles does not act in the axis of the outlet of soft parts (see Fig. 16, p. 18, and Fig. 72, p. 155), but is inclined at an angle toward its posterior wall, so as to cause special pressure upon the perineum.

Hence there are two great aims to be carried out in trying to avoid rupture, first, to delay the too rapid advance of the head; and secondly, to press it forward toward the pubic arch, and so equalise the pressure on the ring of the vulval outlet. To do this both hands should be employed, and, if rupture appears probable, the physician should not scruple to avail himself of the aid of visual inspection, so as to estimate the better the degree of tension which the perineum is undergoing. The index finger of the right hand may be placed on the thin edge of the perineum, so as to note its tension, while the tips of the remaining fingers placed on the occiput check its advance when tension becomes too great. At the same time the left hand is spread out flat behind the perineum, so that the index fingers and thumb press on the head a little in front of the sacro-sciatic ligaments on each side, and direct it forward, without exercising any pressure on the sensitive central portion of the perineum where the strain is greatest. The position of the left hand is the same as that shown in Fig. 223, for the case of extraction by forceps. Thus both hands act together in checking advance, when necessary, while the left hand keeps the head forward against the pubic arch. At the same time that he employs pressure the physician may exercise some control over the "safety-valve" action of the glottis by telling the patient to cry out, and to cease bearing down, when tension becomes dangerous. If the patient is devoid of self-control, and the pains tumultuous, there is a better chance of avoiding laceration if chloroform is administered.

In primiparæ there is an inevitable laceration of the entrance of the vagina proper, marked by the remnant of the hymen, and from this point the laceration may run upward and downward, extending through to the skin. But in general lacerations reaching the cutaneous surface of the perineum run from before backward, commencing at the fourchette, after the inevitable laceration has already occurred, if the patient be a primipara. It is to the anterior edge of the perineum, therefore, that attention must be most closely directed.

There is another mode of directing the head forward, besides that of spreading out the thumb and fingers in front of the sacro-sciatic ligaments, namely, to pass the thumb or fingers through the dilated anus into the rectum and press on the head through the recto-vaginal septum. This is mechanically very effective ; the patient will not generally notice the inconvenience at the crisis of the pain produced by the stretching of the vulva, and there will be no inconvenience to the physician, if the rectum has been previously cleared out by enema. On the whole it is not so desirable a plan as the other. But if the physician has one hand occupied, as by holding a chloroform inhaler, he may completely command the head with his right hand, placing the thumb in the rectum, and the fingers on the edge of the perineum and the occiput. Either by pressure in front of the sacro-sciatic ligaments, or from the rectum, it is often possible to squeeze out the head *in the interval* of pains, and this plan is a good one when the pains are difficult to control.

The treatment required for a distinctly pathological rigidity of the perineum will be considered in Chapter XXVII.

Expulsion of the trunk.—As the head is passing through the vulva the patient's right thigh should be raised by the nurse, to allow the occiput to pass forward in front of the pubes. The head should be received upon the right hand, and by it guided forward close to the thighs, as the trunk is expelled.

As soon as the head has passed the vulva, the physician should see if the funis is round the neck, and if it is, he should, as quickly as possible, slip the loop over the head. If he cannot do this he should try to slip it over the shoulders. If this also fails the funis may be rendered so short that it checks the further advance of the child, and the child will then be in danger of asphyxia from the funis being drawn tight, and the circulation through it stopped. If, therefore, the funis is found to be tight, and cannot be released, it should be cut with scissors, and the proximal end held between the finger and thumb to prevent bleeding, until the child is born, when a ligature can be placed round it.

The trunk is generally expelled by the pain following that which expels the head. As a rule, it is sufficient to wait quietly for the occurrence of the pain. In normal labour there is no danger to the child at this stage, even if the body is not expelled for several pains, the placental circulation being still intact. Moreover, if not already partially asphyxiated, the child is generally able to breathe at this stage, if it requires to do so. If however the child has already been imperilled by prolonged labour, and especially after a difficult forceps delivery, it may be sacrificed by prolonged delay after the birth of the head. Increasing lividity of the face shows the child to be alive. But, if it becomes extreme, and especially if it is accompanied by convulsive twitchings, it is an indication for accelerating delivery. The uterus may then be stimulated by friction, and the woman told to bear down. If the delay is very long, and the sooner if the child appears to be very large, in proportion to the genital canal, the head may be grasped between the hands, and gentle traction, not enough to endanger the spinal cord, may be made upon the neck during a pain. As soon as the posterior axilla can be reached the index finger may be hooked into it, and traction made upon it with greater safety than upon the head.

After the shoulders have passed, the expulsion of the body of the child should be left entirely to nature, since, if the uterus be emptied artificially, it is more likely to remain flaccid, and permit hæmorrhage. The left hand should be placed upon the abdomen, follow down the fundus as it diminishes in size, and make sure that it remains contracted. This is an important measure as a safeguard against hæmorrhage.

If the child breathes and cries freely, it should be laid near the mother's thighs, in such a position that it does not hurt her by kicking against the vulva. If the presence of mucus in the mouth is shown by any rattling respirations, it should be wiped out with a napkin.

As soon as the head appears, the eyes and their neighbourhood should be wiped clean from mucus with a piece of absorbent cotton. If any purulent discharge has been noticed, or if there is any reason to suspect the existence of gonorrhœa, a disinfectant solution such as perchloride of mercury 1 in 2,000 should be dropped into the eyes. The ophthalmia neonatorum, which is often a source of permanent blindness, may thus be averted. In Germany a solution of nitrate of silver, 2 per cent., is much used for this purpose; but it has the drawback that it is apt itself to set up a slight inflammation.

Ligature of the funis.—It has generally been recommended to tie the funis as soon as the child cries or breathes freely. The experiments of Budin,* however, have shown that the opposite practice is desirable. If the funis is left untied, pulsation in it gradually ceases, generally within four or five minutes, the cessation passing from the placental end toward the child. If the funis is not cut till about a minute after pulsation has ceased, there is hardly any bleeding from the placental end. If however, it is tied early, a considerable quantity of blood escapes, the amount of which was found by Budin to be on the average about three ounces (88cc.) greater than in the former case. It may be inferred that this amount of blood is transferred from the placenta to the child during the few minutes after birth, partly from the thoracic aspiration during inspiration, partly from the effect of the pressure of the uterus on the placenta ; and that it serves to supply the extra amount of blood required to fill the pulmonary circulation at the time when the lungs take the place of the placenta as organs of respiration. Hence, we get the startling result that to tie the funis immediately is equivalent to bleeding the child to the amount of three ounces, a bleeding which would correspond to one of about sixty ounces in an adult. The conclusions arrived at from the amount of blood which escapes from the placenta have been confirmed by observations on the increase of the weight of the child during the few minutes after birth. Experience has not yet fully decided as to the relative after-effects upon the children. Most observers consider that the children are more vigorous after late ligation of the funis, and suffer less loss of weight in the few days after delivery. Some have reported that they are more liable to an apparent jaundice, which has been thought to be really due to disintegration of over-abundant blood-corpuscles ; but this jaundice, or apparent jaundice, does not seem seriously to affect the infant.

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* Budin, "A quel moment doit-on opérer la ligature du cordon ombilical?"—"Progrès Médicale," 1876.

On the whole, it may be inferred that the extra amount of blood is an advantage to the child, especially as it gains very little nourishment from its mother during the first two days. If, therefore, there is no necessity for haste on account of the condition of the mother, or in order to resuscitate an asphyxiated child, the funis should not be tied, until the pulsations, near its placental end, have stopped for a minute or more, or, at any rate, till five minutes have elapsed since the birth, if the pulsations continue longer. In the majority of cases the pulsation ceases within three or four minutes, but sometimes it continues as long as fifteen minutes or more. Such prolonged pulsation may occasionally be an indication of adherent placenta.

The material commonly prepared by the nurse for tying the cord consists of several strands of strong thread, tied together at both ends. A narrow tape answers equally well. The knot should be tightened gradually and firmly, in order to compress the elastic gelatinous material of the cord, especially in cases in which this is unusually abundant, otherwise bleeding may occur after an interval. When the funis is very thick, it should always be looked at after a while, to make sure that the ligature is safe. The ligature may be placed as close to the umbilicus as one inch provided that there is no umbilical hernia. The funis is then cut with scissors about half an inch beyond the ligature, care being taken that no injury is done to the limbs of the infant. It is quite unnecessary to place a second ligature on the placental side if the plan has been adopted of waiting for the cessation of pulsation, as only a few drops of blood will escape. The only case in which the second ligature ought to be used is that in which the hand placed on the uterus finds it still so large that it may have within it a twin fœtus. The object in this case is to prevent any loss of blood to the second fœtus, in case there should be a single placenta and inosculation of the fœtal vessels.

Management of the third stage of labour.—In ordinary cases of labour, a correct management of the third stage is the most important of all the duties of the physician ; and it is at this stage that erroneous practice is still most frequent. Only a few years ago, the method taught in most text-books was to wait for a certain interval after delivery for contraction of the uterus, and then to pass the fingers into the vagina and trace up the cord, feeling for its insertion into the placenta. If the insertion could be felt, the cord was to be wound round the fingers of one hand, so as to give a purchase for pulling, while the fingers of the other hand in the vagina were placed on the cord, so as to direct the traction at first backward in the axis of the pelvic inlet. In practice, it has not been uncommon to remove, or attempt to remove, the placenta by traction on the funis, even when the insertion of the latter could not be felt, the placenta being still wholly in the uterus. The objection to this method is, that any traction whatever on the funis pulls away the *centre* of the placenta from the uterine wall, and so creates a vacuum which must be filled up either by blood poured out from the uterine wall, or, less frequently, by entrance of air from outside. Moreover, by drawing down the placenta like an inverted umbrella, it interferes with the natural mechanism of its expulsion (see Figs. 96, 97, p. 200), and renders its bulk greater for passing through the cervix and vagina. Practitioners who adopt the correct mode of management of the placenta, and are unremitting in their vigilance, are almost exempt from the grave accidents of post-partum hæmorrhage, and, moreover, save many patients from the inconvenience of after-pains, excited by the formation and retention of clots within the uterus.

Expression of the placenta.—The correct mode of aiding the delivery of the placenta, when aid is required, is that of external pressure. This method is often spoken of as the method of Crédé, although Crédé only revived a mode of treatment previously known, though not generally practised. During the birth of the body of the child the physician is to follow down with his hand the contracting uterus, and by pressure and, if necessary, gentle friction, stimulate it to maintain its retraction after the child is born. It is not desirable, by forcible pressure, to attempt to completely expel the placenta with the same pain which expels the child, or immediately afterwards. For if the uterus be completely emptied before thrombi have had time to form in the vessels, it is more apt to relax again quickly, not being stimulated by the presence of the placenta within, and so to allow hæmorrhage to take place.

Provided that there is no hæmorrhage, it is better to wait from ten to fifteen or twenty minutes after the birth, to allow the thrombi to form. Meanwhile, the physician keeps his hand upon the uterus to make sure that it does not relax and dilate ; or, while he is engaged in tying the funis, or otherwise attending to the child, directs the nurse to place her hand upon it. After a sufficient lapse of time, gentle uterine contractions will probably be beginning to recur. These are to be stimulated by a more active pressure, combined with friction over the fundus. As soon as an active contraction is called forth by these means, so that the fundus becomes quite hard under the hand, the fundus is grasped with the palm of the hand and fingers, and circular compression made upon the body of the uterus, at the same time that it is pressed downwards in the direction of its axis. The expulsion of the placenta out of the uterus into the vagina is known by the diminution in the size of the uterine body. By continuing the pressure downwards in the axis of the pelvis, the physician may then generally complete the expression of the placenta out of the vagina and into the bed. At this stage, or when the placenta has been spontaneously expelled up to this point, if he can feel the *lower margin* of the placenta in the vagina, there is no harm in seizing that with the finger and thumb, and aiding the pressure from above, during the uterine contraction, with gentle traction upon it, care being taken not to use force enough to tear its lacerable substance. If the whole placenta has been expelled out of the body of the uterus, below the retraction ring, and lies entirely in the vagina and relaxed cervix, no injury is done by extracting it by traction on the funis. There is, however, this objection, that it is sometimes difficult to be sure whether any of the placenta remains in the uterus, and that those who accustom themselves to this mode of extraction are therefore apt to use it in unsuitable cases. If the expression of the placenta does not succeed with the first pain, it should be repeated with successive pains, without using undue force, until the placenta is gradually detached. As the placenta passes through the vulva it should be rotated several times on its long axis, so as to twist up the membranes into a kind of cord, which is to be withdrawn very gradually, so as to avoid its tearing. If it is felt to begin to tear, it should be seized by the fingers in the vagina at a higher point, and so extracted.

In general, the expression of the placenta can be carried out with the patient still in the left lateral position, in which she has been delivered, either right or left hand being used to compress the fundus. If any difficulty occurs in the expression, or if there is any hæmorrhage, the physician can more easily command the uterus if he places his patient on her back, and presses in the ulnar border of the left hand behind the fundus, with the thumb over the front of the uterus. Two hands may be used if the uterus is very large If the uterus is large and relaxed, it is not desirable to press it too strongly *downward*, for this might cause an inversion, but rather to stimulate it to contract by friction and circular compression.

There is only one drawback to the method of expression of the placenta, namely, that patients who have been accustomed to have it removed by traction on the cord sometimes find more discomfort from the pressure on the uterus than they experienced from the other mode of proceeding. The only remedy for this is not to use much force, but effect the expulsion from the uterus gradually, with successive pains.

Examination of the placenta.—The bag of membranes will generally have become inverted, and will require reinversion to bring the uterine surface outermost. The first step is to examine the uterine surface of the placenta, and make sure that it is complete, especially along the margin, and that no part is left behind in the uterus. Any adherent clots should first be washed away from the surface. If the cotyledons are partially separated, the placenta should be spread out flat, or with the uterine surface somewhat concave, and then it will be possible to see whether the parts all fit together, and none is missing. In this examination, any hardened, degenerated or calcareous patches on the surface will be noted.

The next step is to see that the whole of the two layers of membranes, amnion and chorion, are present. They are most easily separated at the edges if placenta and membranes are placed in a basin of water. The chorion is outermost and continuous with the edge of the placenta. The amnion can be stripped up to the insertion of the funis. The experienced accoucheur will judge at a glance that none of the chorion is deficient, by the whole of the membranes having a rough outer surface, due to the portion of decidua remaining attached to the chorion. The amnion is smooth on both sides, thinner but stronger than the chorion. There should be sufficient membranes present to have enclosed the fœtus, allowance being made for the shrinking due to their elasticity. Except in the case of placenta prævia, where the membranes have been ruptured at the edge of the placenta, there should be a border of them all round, but deeper at one part than another.

It is to be noted that the chorion is more likely than the amnion to be left behind in the uterus, wholly or partially. The amnion is not likely to be left behind when the chorion comes away; but it may be torn away from the edge of the placenta and separated from the chorion, when it has been carried down as a caul, or as a bag descending far in advance of the head. When the amnion has been torn away, special care is necessary to make sure that none of the chorion has been left behind.

If a placenta succenturiata had been left behind in the uterus, the fact would be revealed by a corresponding deficiency in the chorion, and by the torn ends of the vessels which supplied it, passing from the edge of the main placenta, or separately from a velamentous insertion of the funis.

If any portion of the placenta or membranes appears to be absent, it must be sought for within the uterus and removed. In any case, it is well to introduce the finger into the vagina, to ascertain whether the cervix has undergone any laceration which is likely to call for subsequent treatment. At the same time any clots in the vagina, or easily within reach in the lax cervix, may be removed. A hot douche at about 105° F. may then be given, either of mercurial solution as already described (see p. 206), if that has not been used before delivery, or of carbolic acid, 1 in 50.

Examination of the perineum.—After the delivery of the placenta a careful examination should be made as to whether there is any laceration of perineum, so that any rent may be immediately sewn up. Visual examination is better than digital; and, if there is any doubt, a good light must be obtained for the inspection. Many lacerations remain unobserved for want of a visual examination. The mode of treating any laceration will be hereafter described.

Use of the binder.—The object of the binder is not to serve as a prophylactic against hæmorrhage, for which purpose it is worse than useless, but simply to supply that support to the abdominal viscera which is taken away by the sudden diminution of tension. The binder should never be applied until at least half an hour has elapsed since the birth of the child, and a sufficient continuous contraction of the uterus has been secured. Up to that time the physician should keep his hand on the uterus, observing its condition, kneading it if it becomes large and soft, or hæmorrhage occurs, but remembering that a certain alteration of hardness and softness is the physiological law. If there is any excess of sanguineous discharge, or if the contraction of the uterus is unsatisfactory, he must continue this observation for a longer time, until he is certain that there is no longer risk of hæmorrhage. The pulse at this time will generally have fallen down to, or even below, its normal level, and an unusually rapid pulse, such as one of 100 or more per minute, unless accounted for by the severity of the labour, or other known cause, must be taken as indicating a risk of hæmorrhage. As a greater security against hæmorrhage, it is recommended by some to give after delivery of the placenta, as a routine practice, a dose of ergot, about a drachm of the liquid extract, or the liquor secalis ammoniatus. In the case of a strong healthy woman, whose uterus has been acting vigorously, this seems unnecessary, but it should always be given to a weakly patient, or when there has been any indication of uterine inertia or tendency to hæmorrhage. Its use in such cases, by preventing the formation of clots, tends to avert after-pains, as well as hæmorrhage. According to Herman's* observations, the use of the binder makes no difference as regards the subsequent size of the abdomen. But if a lady, in future years, is not quite satisfied with her figure, she will be apt to lay the blame on an accoucheur who omitted the use of the binder. It is possible that its use is in reality some safeguard against persistent flaccidity of the abdominal wall and consequent pendulous abdomen.

In applying the binder the soiled linen and napkins should first be removed, and the draw-sheet shifted, the patient being disturbed as little as possible. The binder should be wide enough to reach from the ensiform cartilage to the pubes, and long enough to overlap across the abdomen only. One end is rolled up to pass it beneath the patient, and care must be taken that it is spread out evenly, and low enough down over the hips. The nearer end is then laid over the abdomen, and held at its lower margin with the left hand, while the right hand draws the further end smoothly over it. The two layers are then held together, at the desired tension, by the left hand, while the right hand fixes them with large safety-pins going from below upward. The first pin is placed close to the lower margin of the binder, which should pass below the level of the great trochanter; the second a little below the level of the crest of the ilium; the third above the level of the crest of the ilium. These three pins are sufficient, but a fourth may be placed higher up. It is a good plan to place a folded towel under the line of pins, not as a pad, but to make it easier to avoid pricking the skin in inserting the pins. A thin layer of cotton wool wrapped in gauze or muslin may be used for the same object. A pad is sometimes placed underneath the binder, with the idea of compressing the fundus. This generally pushes the fundus on one side, and it is very doubtful whether it is of any use in maintaining contraction. If any pad at all is used, the best is a small saucer, wrapped in a napkin, and placed with its concave surface over the fundus, so that it does not get displaced.

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* Obstet. Trans., Vol. XXXII.

After the application of the binder the mother should be left perfectly quiet to rest, and if possible, to sleep. An opiate is not necessary, as a general rule, but some light nourishment, such as an egg beaten up with milk, or beef tea, may be given with advantage.

Use of Anæsthetics in labour.—In the great majority of cases of labour where an anæsthetic is required chloroform is the one to be chosen. Even when it is necessary to give it to the full surgical extent, as in obstetric operations, it does not appear to involve the same increased risk, as compared with other anæsthetics, such as ether, which it does in ordinary cases. The explanation of this is probably to be found in the physiological hypertrophy of the heart which occurs during pregnancy, in the stimulation of heart and lungs which occurs during each labour pain, even when the patient is pretty deeply anæsthetised, and perhaps also to some extent in the high abdominal pressure due to the presence of the pregnant uterus. All these causes diminish the risk of sudden anæmia of the brain. If vomiting occurs, and food is present in the stomach, it is of course necessary, whatever be the anæsthetic used, to see that the patient does not get suffocated through the vomited matter obstructing the larynx. If given to the partial extent which alone is ever necessary in normal labour, chloroform may be regarded as entirely free from risk. Ether is more disagreeable to the patient than chloroform, and has not the same satisfactory effect of deadening pain when given in partial degree. Most of the objections formerly made to the use of chloroform in normal labour have not now to be considered; and, as a rule, it may always be given whenever the pains are felt acutely, or the patient is desirous to take it. Its use is a distinct advantage, putting aside the question of relief of pain, in those cases in which the pains are too violent, or occur at too short intervals. There are, however, two drawbacks to its use; first, that it tends to diminish the vigour of the pains, and so is apt somewhat to increase the duration of labour; secondly, that it increases the risk of post-partum hæmorrhage in patients predisposed to that accident. These disadvantages may be avoided to a great extent by not giving the chloroform too freely. When, however, there is manifest inertia of the uterus or a history of post-partum hæmorrhage on former occasions, it is better to avoid it entirely, or give it only in infinitesimal degree. Thus, when a patient is very anxious to take chloroform, and its effect appears undesirable, a very little chloroform may be mixed with Eau-de-Cologne.

Anodynes in the first stage of labour.—As a rule chloroform should not be given until the pains of the expulsive stage begin. If the pains of the first stage are very distressing to the patient, and especially if at the same time the os is rigid and slow in yielding, either chloral or some preparation of opium, such as Battley's liquor opii sedativus, may be given. The effect is often not only to diminish pain but to lessen spasmodic rigidity of the os, and allow the patient to recruit her strength by some sleep in the intervals of the pains. Chloral is generally preferable to opium. Two doses of fifteen grains may be given with from half an hour to an hour's interval, and the dose repeated, if necessary, after two or three hours. If there is sickness, and the medicine cannot be retained, a moderate hypodermic injection of acetate of morphia (a sixth or a quarter of a grain) may be administered. In some cases, however, of muscular rigidity of the os, especially when the uterus is active, and the membranes have ruptured prematurely, chloroform is found to be far more efficacious than chloral, and in such instances it may be desirable to give it, even in the first stage of labour.

Chloroform in the second stage.—The chloroform is to be given in such a way as only to dull sensibility, and not to produce complete anæsthesia, or entirely abolish self-control. For this purpose it may be sufficient to place the inhaler over the face only during the pains, allowing the patient to come round in the intervals. The chloroform may be dropped on any simple form of inhaler (such as Skinner's) or on a handkerchief held an inch or two from the nose. If more convenient, the patient may be allowed to hold the inhaler herself, provided the physician makes sure that she is actively holding it, not allowing it to rest passively over or near the face. Junker's inhaler is a very good one for administering the chloroform. The patient may herself hold the mouthpiece, while the physician with his left hand works the bellows, without having to lean over the patient, and has his right hand free. This inhaler economises greatly the quantity of chloroform used, and is safer than any other for the administration of chloroform to the surgical degree. As the chloroform is given more gradually with this inhaler, it must be continued to some extent during the intervals, as well as during the pains, sufficiently to render the patient somnolent in the intervals, and only partially conscious during the pains. Just as the head is about to pass the vulva, if the pains come on with increased vigour, the administration may be pushed more nearly to the point of complete anæsthesia.

When anæsthesia to the surgical degree is required, as for obstetric operations, it is desirable to have another person for administering the anæsthetic, who may give his whole attention to that duty. It is frequently convenient to be able to apply forceps without the necessity for having an assistant. In such case, if chloroform be given, it should only be to a degree short of abolishing the patient's self-control, otherwise the partial anæsthesia renders the operation much more difficult. As an anæsthetic for obstetric operations chloroform has the advantage over ether that it more completely relaxes the uterus, when given to the full extent. This is especially of advantage in the operation of version. Ether, however, is to be preferred, if an anæsthetic is indispensable, in cases in which the patient is greatly exhausted and the pulse feeble, as for instance after severe ante-partum hæmorrhage.

In the third stage the administration of chloroform involves a risk of relaxation of the uterus and consequent hæmorrhage. It should not therefore be given at this stage, unless it is required for the removal of an adherent placenta.

CHAPTER XIV.

FACE PRESENTATIONS.

Although labour with face presentation cannot be regarded as normal, yet, in the great majority of cases, it is completed naturally. The mechanism of labour in face presentation has great analogy to that in the vertex presentation and should therefore be considered in close relation with it.

In face presentation, the head, instead of being flexed upon the sternum, is extended, so that the occiput is reflected upon the back, and the face and forehead form the presenting part (see Fig. 99). The consequence is that the chest is thrown forward against the uterine wall, and the back is separated from it. In face presentation, the action of the lever formed by the diameter of the head which is thrown across the pelvis (see p. 176), acted on by the resistance at its two extremities, is reversed. The fulcrum of the lever is now formed by the point C (Fig. 100), where the line of force, acting through the condyles, cuts the fronto-mental diameter, F M. This fulcrum is now nearer, not to the posterior, but to the anterior end of the lever (compare Fig. 100 with Fig. 83, p. 176). The posterior arm of the lever is therefore the longest, and has the mechanical advantage. The head therefore, instead of tending to become flexed, becomes more and more extended, until the chin becomes the most advanced point.

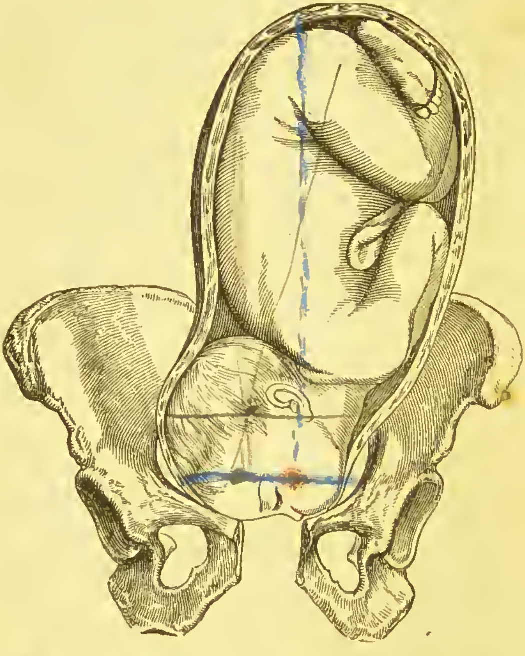
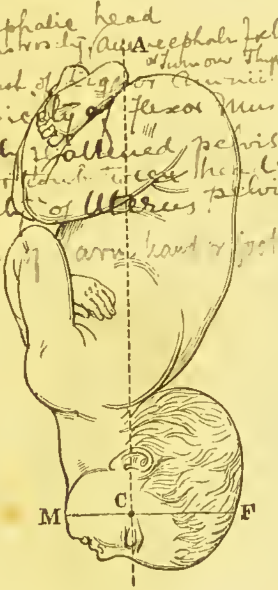


Fig. 99.—Presentation of the face at the pelvic brim in the second facial position.

It follows that there must be some intermediate position of partial extension in which the two arms of the lever are equal, and their action balanced. From this position, if ever so little flexion occurs, the anterior arm of the lever gets the advantage, flexion progresses, and ordinary vertex presentation results; if ever so little further extension occurs, the posterior arm of the lever gets the advantage, extension goes on, and face presentation is produced. This intermediate position is called *brow presentation*, the prominence of the forehead being the presenting point, and the anterior fontanelle and the root of the nose within reach at about equal distances in opposite directions. As it is thus a position of unstable equilibrium, the head could never pass through the pelvis in brow presentation, even if there were room for it so to pass. Generally there is not room, the vertico-mental, or longest diameter of the head, being thrown across the pelvis. The head may, however, be arrested in a position of a brow presentation, though even this is very rare; and when this happens, there is considerable difficulty in effecting delivery. As a general rule, brow presentations are converted, not into vertex, but into face presentations. For there must have been some cause leading to the partial extension, and this will generally go on to produce complete extension, the head-lever no longer tending to counteract it. It is thus evident that all cases of face presentation must have passed through the stage of brow presentation, in their deviation from the normal condition.



es.
cho-cephalic head
al monstrosity, anencephalic feto
tumour
or Chorii
flexor muscles
pelvis
pelvis
of uterus
arm

Fig. 100.—Diagram of head-lever in face presentation.
A C, axis of expulsive force passing through condyles.
F M, fronto-mental diameter of head.
C, fulcrum of lever.

Frequency of Face Presentation.—The frequency of face presentation is variously estimated by different authors. The statistics of the Guy's Hospital Lying-in Charity (out of 49,145 cases) give ·33 per cent., or 1 in 303; Churchill (out of nearly 250,000 cases collected) gives the frequency as 1 in 231; Collins, for the Rotunda at Dublin, as only 1 in 497; Pinard, for the Maternité at Paris (out of 81,711 cases) as 1 in 225; Spiegelberg, from German statistics, as 1 in 324. It appears therefore that no uniform difference is produced by the dorsal position in labour generally adopted on the Continent.

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Causation.—One of the causes which may tend to produce face presentation is the peculiar shape of the child's head, namely, what is called the dolicho-cephalic shape, in which the occiput projects more than usual, and the posterior arm of the head-lever is therefore not so much as usual exceeded in length by the anterior in its normal position (see Fig. 83, p. 176). There is no doubt that this cause will tend to facilitate face presentations, if it exists, but it is not positively decided whether it is, in point of fact, a cause commonly in operation. Budin,* measuring the shape of heads born in face presentations, found that, after the moulding of labour had passed off, they were not dolicho-cephalic. Hecker,† on the contrary, who attaches much importance to this shape of the child's head, has reported instances in which the elongation of the occiput did persist after delivery. It is clear, however, that this cause is not sufficient by itself, as the anterior arm of the lever is always somewhat longer than the posterior.

Some forms of fœtal monstrosity produce a face presentation during pregnancy, persisting in labour. The chief of these are the anencephalic fœtus, and the fœtus deformed by tumour of the thyroid gland.

Any accidental cause leading to a partial extension may produce face presentation, since the resistances will complete the extension, if once it has passed beyond the neutral point of unstable equilibrium (or brow presentation). Such a partial extension may arise from a sudden gush of profuse liquor amnii, or from an oblique position of the child in the uterus at the time when the membranes rupture. This is more likely to happen when the child is dead, for then there is not the tonicity of flexor muscles which maintains the chin-flexion, as well as flexion of limbs, in the usual attitude of the fœtus. Even a want of tone of flexor muscles in a living child may promote it.

Face presentation is promoted by disproportion between the head and the pelvis, for, if the head is detained above the brim, displacement is more readily produced by any cause. A particular form of pelvic deformity may actually cause it, namely, the generally flattened or elliptic pelvis,‡ not specially contracted in the conjugate diameter. The chief resistance may then be at the ends of the biparietal diameter, especially if the head has prominent and firmly ossified parietal tubera, instead of at the ends of the long antero-posterior diameter, or that opposed to the conjugate of the pelvis, which is generally nearly the bitemporal diameter. In such case, the resultant of the resistances may fall posterior to the condyles instead of in front of them, and then more or less extension will be produced, the occiput being more resisted than the front part of the head.

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* "De la Tête du Fœtus au point de vue de l'Obstétrique."

† "Ueber die Schädelform bei Gesichtslagen."

‡ See Chapter XXIX.

A cause of face presentation which is now generally considered to be one of the most important is *obliquity of the uterus*, and therefore of the propelling force, and this is a cause which may be combined with any of the others. For suppose the fundus uteri to be inclined to the right side, and the child to be lying with its back toward the right, that is, in the second or third position. The propelling force is then inclined toward the left, and therefore tends to push the condyles in that direction, or toward the face of the child. The head is thus pressed against the left pelvic wall, and the reaction of the pelvic wall forms a force tending to push in the opposite direction (that is, toward the right side of the pelvis, and toward the occiput of the child), either the forecoming part of the head, if the head is not fully engaged in the pelvis, or the centre of the head, if it is engaged. In either case, there is thus produced what in mechanics is called a "couple," that is a pair of equal forces acting in opposite directions, but in parallel, not in the same straight lines.* The tendency of this pair of forces is not to move the centre of the head, but to rotate it on a transverse axis, so as to produce extension. If the obliquity of the propelling force is considerable, this effect may overcome the forces tending to produce flexion, and so lead to face presentation. Similarly, an obliquity of the uterus toward the left side tends to produce extension when the back of the child lies toward the left, that is, in the first and fourth positions.

Statistics afford some evidence that this cause is actually in operation. For in vertex presentation left dorsal positions predominate in the proportion of about three to one, but in face presentations only in the proportion of about four to three. It must be inferred that a face presentation is much more easily developed out of a vertex when the back of the child lies to the right. This is explained by the usual obliquity of the fundus uteri toward the right side.

An anterior or posterior obliquity of the uterus acts in a similar way. A posterior obliquity of the uterus, in reference to the axis of the brim, which in some degree is probably a normal condition

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* Each of the forces forming the couple is equal to the component of the propelling force resolved (by the parallelogram of forces) perpendicularly to the axis of the pelvis. The oblique propelling force, together with the reaction of the lateral pelvic wall, is equivalent to a force acting in the axis of the pelvis, tending to produce onward movement, and the couple, tending to produce rotation on a transverse axis, that is, extension.

(see p. 167), tends to cause extension in occipito-posterior positions (third and fourth), an anterior obliquity (such as occurs from pendulous abdomen) in occipito-anterior positions (first and second). Here again, we find the third and fourth positions are relatively commoner in face than in vertex presentations, while posterior obliquity of the uterus is more usual than anterior, and thus the theory of causation by obliquity of propelling force is again confirmed.

Varieties of Face Presentations.—In face, as in vertex presentation, there are four positions, each of which is developed out of the corresponding position of the vertex. It is usual to name them from the position of the chin (*e.g.*, left mento-anterior). The four following will then be the positions of the face :—

First or right mento-posterior, R. M. P.—The long diameter of the head approximates towards the right oblique diameter of the pelvis. The chin points toward the right sacro-iliac synchondrosis, the forehead toward the left foramen ovale.

Second or left mento-posterior, L. M. P.—The long diameter of the head approximates toward the left oblique diameter of the pelvis. The chin points toward the left sacro-iliac synchondrosis, the forehead toward the right foramen ovale.

Third or left mento-anterior, L. M. A.—The long diameter of the head approximates toward the right oblique diameter of the pelvis. The chin points toward the left foramen ovale, the forehead toward the right sacro-iliac synchondrosis.

Fourth or right mento-anterior, R. M. A.—The long diameter of the head approximates toward the left oblique diameter of the pelvis. The chin points toward the right foramen ovale, the forehead toward the left sacro-iliac synchondrosis.

As in the vertex positions, the first and third and the second and fourth are the reverse of each other. The first position is still the commonest, but only in slight proportion. The fourth is relatively not so rare as in vertex presentations. The reason for the differences has already been explained.

In comparing any position with the corresponding position of the vertex, it must be noted that the words right and left, anterior and posterior, are reversed, because the face position is named by its anterior extremity, the vertex by its posterior. Thus the first vertex position, or left occipito-anterior, becomes by extension the first face position, or right mento-posterior. It will be seen shortly, however, that the right mento-posterior position of the face corresponds *mechanically* to the right occipito-posterior or third position of the vertex, the chin being the most prominent part of the one, the vertex of the other. Similarly for the other three positions.

MECHANISM OF LABOUR IN FACE PRESENTATION.

The mechanism of the passage of the head will first be described for the case in which the face lies in the first or right mento-posterior position. As in the case of the vertex, four principal subsidiary movements take place in conjunction with the movement of descent of the centre of the head along the curved axis of the pelvis. These are enumerated as follows :—

EXTENSION.
INTERNAL ROTATION.
FLEXION.
EXTERNAL ROTATION.

Extension.—It has already been explained that the posterior arm of the head-lever, instead of the anterior, is now the longest. The resistances therefore produce progressive extension instead of flexion, the resistance tothe forehead having the mechanical advantage over that to the chin, until the chin becomes the most advanced point, and extension is at last checked by the occiput being compressed against the back (see Fig. 99, p. 227). Not only the action of the head-lever, but the shape of the presenting part, is the reverse of that in vertex presentations. The anterior extremity,

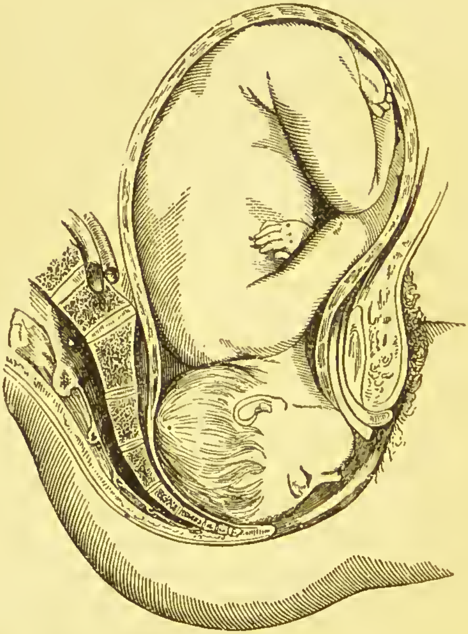

Fig. 101.—Rotation of chin under pubic arch in face presentation.

the chin, instead of the posterior, is now the most prominent and projecting part, the forehead being more gradually rounded. Hence the chin in face presentation corresponds *mechanically* to the occiput in vertex presentation. When the face is lying over a not quite fully expanded os uteri, this shape of the presenting part also favours extension, just as the shape of the vertex favours flexion in vertex presentations (see pp. 177, 178).

Internal rotation.—The chin, descending in advance of the forehead, is the first to meet the resistance of the inclined plane formed by the soft parts at the posterior part of the pelvic floor (see Fig. 73, p. 156), and by it is pushed forward into the free space under the pubic arch, just as the occiput is usually pushed forward in occipito-posterior positions. The chin then comes to be directed almost exactly forward, as shown in Figs. 102, 103, 104. Thus the internal rotation takes place through nearly three-eighths of a circle. The first position of the face corresponds mechanically to the third position of the vertex, and is converted into the fourth position of the face by a *long* rotation, just as the third of the vertex is converted into the second. Like the occiput in occipito-posterior positions, the chin may be rotated forward either early or late, but more frequently late. Early rotation, when it occurs, is due to the pressure of the elastic recto-vaginal septum. When extension is incomplete, rotation is more likely to be delayed; and for a time,

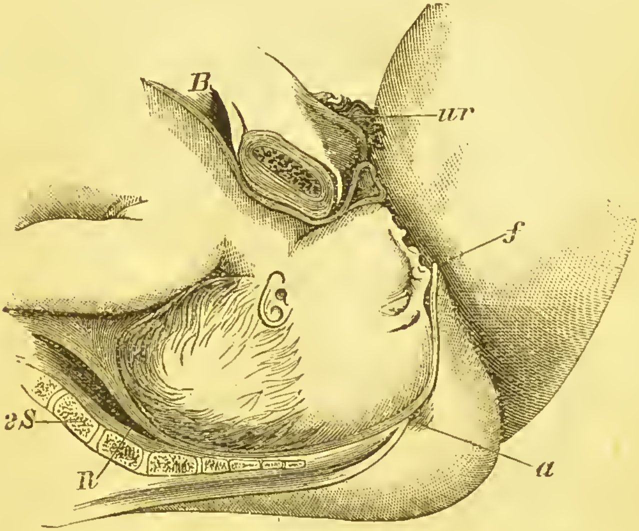

Fig. 102.—Distension of intact perineum in face presentation. The elongation of occiput produced by protracted labour is also shown. *B*. Bladder. 2 *S*. Second sacral vertebra. *R*. Rectum. *a*. Anus. *f*. Fourchette. *ur*. Orifice of urethra. (After Schroeder.)

in the earlier part of its descent, the chin may be rotated somewhat backward, in consequence of the screw-like shape of the bony pelvis, the posterior inclined plane of the ischium directing the chin backward, if the presenting part fits tightly in the bony pelvis.

It hardly ever happens that the chin remains posterior like the occiput in unreduced occipito-posterior positions. It is scarcely possible for the head to be delivered spontaneously in this way, unless it is excessively small in relation to the genital canal, or the perineum extremely deficient. Sometimes, however, a small head may be delivered artificially in this position, the chin being hooked over the perineum. Sometimes the rotation only occurs just as the face passes the outlet, and the chin may then escape almost in a lateral position, the internal rotation being incomplete.

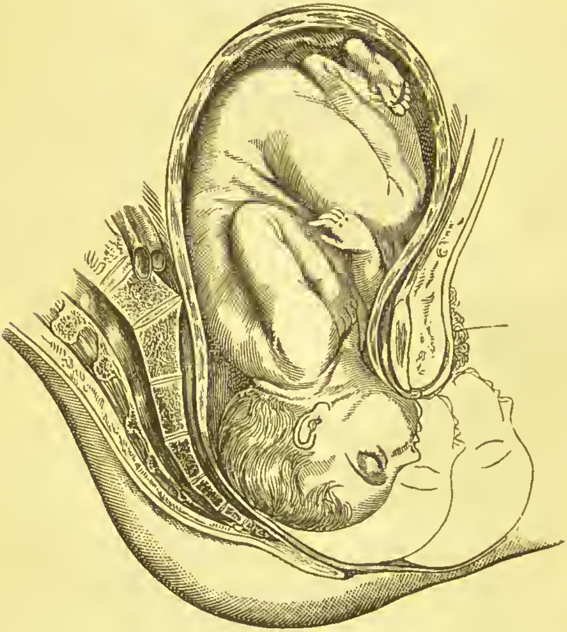

Fig. 103.—Passage of the head under the pubic arch by a movement of flexion in face presentation.

The mechanism of the second position of the face corresponds exactly to that of the first, right and left being interchanged. In the third position the chin has only to rotate through about one-eighth of a circle, until it is directed nearly forward, and the mechanism corresponds to that of the first position of the vertex, a *short* rotation occurring in each case. In this case, the anterior inclined plane of the ischium guides the chin forward in the earlier part of the descent of the head. The mechanism of the fourth position corresponds to that of the third, right and left being interchanged. It is equivalent mechanically to the second position of the vertex.

Flexion.—The fore-coming part of the head is pushed forward as soon as it meets the inclined plane at the floor of the pelvis. The after-coming part of the head is prevented from moving forward by the resistance of the pubes, and by its attachment to the neck. Hence, since the front of the child is now directed forward, the chin either having rotated forward, or being anterior from the first, a movement of flexion is produced, as at the termination of unreduced occipito-posterior positions of the vertex (see p. 184). The chin escapes under the pubic arch, while first the forehead and then the bregma and occiput pass over the perineum (Fig. 103, p. 234). The forehead moves faster than the chin, having to go along the outside of the curve, while the chin moves along the inside, but the chin is not arrested. The greatest diameter of the fœtus opposed to any antero-posterior diameter of the genital canal is one which passes through the posterior part of the head behind the anterior fontanelle, since in this the thickness of the neck has to be included (see Fig. 102, p. 233).

External rotation.—After the head has escaped from the perineum, the face generally turns again towards the side which it originally occupied. As in vertex presentation, this rotation is, in part, instantaneous, as soon as the head is released, to accommodate the head to the position of the shoulders at that moment. Later on the rotation becomes more complete as the bis-acromial (or transverse) diameter of the shoulders turns nearly into the antero-posterior diameter of the outlet. The first part of the rotation is sometimes called *restitution.*

Lateral obliquities in face presentation.—Lateral or Naegele-obliquity of the head is not so often observed in face as in vertex presentation, because the large bi-parietal diameter is now situated nearer to the after-coming than to the fore-coming part of the head. It may, however, occur in some cases, where labour is difficult, or the pelvis contracted, especially when posterior obliquity of the uterus, in reference to the axis of the brim, exists, and the anterior side of the face then becomes deepest in reference to the plane of the brim. In the latter stage, the chin-flexion of the head, on approaching the outlet, is accompanied by some lateral flexion toward the anterior shoulder, just as the extension of the head is, in vertex presentations, toward the outlet of the canal of soft parts (see p. 189), and for the same reason.

Contrasts between the mechanism of face and vertex presentations.—It will thus be seen that while the mechanism of delivery in face and vertex presentations is closely analogous in many respects, it is contrasted in the following particulars :—In face presentation extension takes the place of flexion in the earlier stage, and flexion takes the place of extension in the later stage. In vertex presentations, the commoner positions, the occipito-anterior, are the more favourable, a short rotation only being required ; in face presentations, the commoner positions, the mento-posterior, are the less favourable, a long internal rotation being required. In vertex presentations, the first and second positions remain unchanged; the third and fourth are generally converted into the second and first respectively. In face presentations, the first and second positions are almost invariably converted into the fourth and third respectively ; the third and fourth remain unchanged.

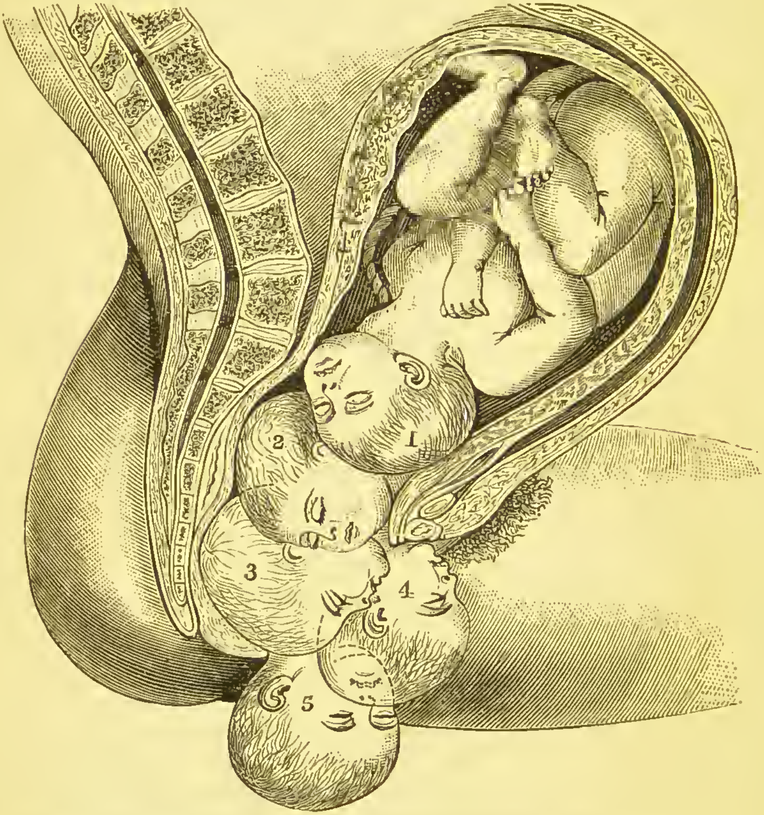

Fig. 104. —Successive stages of first, or right mento-posterior, position of face.

Descent is accompanied by extension and internal rotation till the chin is beginning to approach the pubic arch. Then flexion is substituted for extension ; and descent, internal rotation, and flexion go on together till the head has escaped at the vulva. Then external rotation is substituted for its opposite, internal rotation. The successive stages of a mento-posterior position are shown in Fig. 104 (p. 236).

Caput succedaneum in face presentation.—The swelling upon the presenting part is often very considerable in face presentation, labour being generally more protracted than in vertex presentation. The features thus become excessively distorted, the lips being enormously swollen, and the eyelids also swollen so much that the eyes are closed at birth. There may be also effusion of blood in the conjunctivæ. While the chin is posterior, the centre of the caput succedaneum formed is near the eye; in mento-anterior positions, or after rotation of the chin forward, it is at the lower part of the cheek near the angle of the mouth. The swelling of the features passes off in a few days.

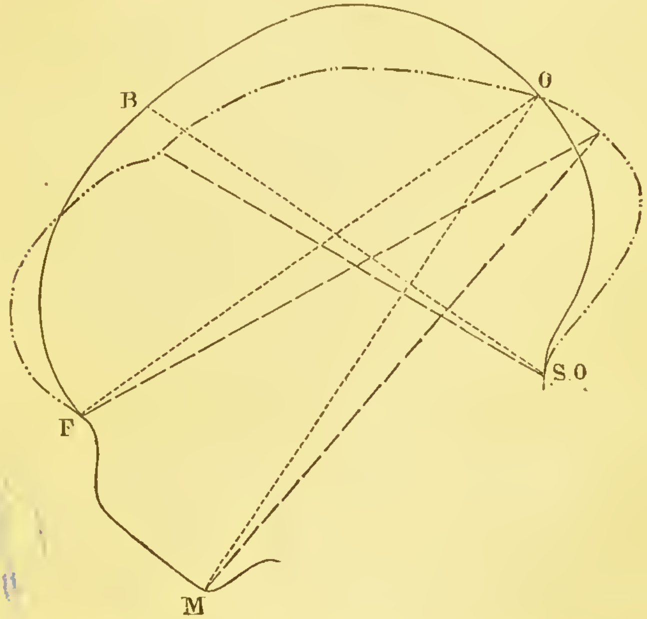

Fig. 105.—Moulding of head in face presentation. The continuous outline shows the head before, the dotted outline after moulding. F O, fronto-occipital diameter; M O, mento-occipital; S O—B, sub-occipito-bregmatic. (After Budin.)

Moulding of the head in face presentation.—The moulding of the head in face presentation is shown in Fig. 105, taken from Budin's measurements. The convexity of the frontal and occipital bones is increased, while the parietal bones are flattened, so that the curvature of the sagittal suture is diminished.

The squamous portion of the occipital bone is rotated backward, so that the occipital protuberance becomes unusually prominent. The chief diminution is in the vertical or cervico-bregmatic, and in the sub-occipito-bregmatic diameters (S O—B); the compensatory increase is chiefly in the fronto-occipital diameter (F O), but there is slight increase also of the mento-occipital (M O). Fig. 102 (p. 233) also shows the relation which the moulding of the head has to the pressure of the genital canal. The prominence at the anterior part of the forehead (shown in Fig. 105), generally seen after face presentation, does not seem easy to account for, except on the view that it is formed when the case is going through the stage of brow presentation, at which time the forehead is the most unsupported part.

Diagnosis.—The face may be distinguished from the vertex, even before the rupture of the membranes, by the unevenness of the features, compared with the uniform hardness of the cranial bones. As a rule, however, a face presentation is not fully developed until the membranes have ruptured, and the resistance comes into play. Whenever there is even a suspicion that the face is presenting, the utmost care and gentleness must be used in vaginal examination, to avoid the risk of injuring the eyes. If there should be any difficulty in making out the presentation per vaginam, on account of the head being very high up, or the os not being dilated enough, assistance may be derived from examination of the abdomen. When the head is high up, and the chin directed backwards, the back of the head, and the depression between it and the child's back, may be made out a little above the brim towards one side of the front of the pelvis, especially if bimanual examination is employed. The fœtal heart will be heard most distinctly on the *same* side as that on which the limbs are felt, instead of on the *opposite* side, as in vertex presentations (see p. 129).

The only other part which might possibly be mistaken for the face on vaginal examination is the breech. The distinctive points to be sought for on the face are the root of the nose, the nostrils, the hard, toothless, alveolar ridges in the mouth, and the chin. In the breech, the anus, grasping the finger with its sphincter, the bony prominences of the sacrum, and the presence of thick meconium, undiluted with liquor amnii, are distinctive.

Prognosis in face presentation.—The prolongation of labour common in face presentation renders the prognosis much more unfavourable for the child than in vertex presentation. Thus, in 166 cases of face presentation in the Guy's Hospital Lying-in Charity, the proportion of children still-born was 8·4 per cent. In vertex presentations during the same time, the proportion of children still-born (including premature children) was only 2·7 per cent. Out of these 166 cases of face presentation, artificial delivery was found necessary in seven. One child was delivered by version, four by forceps, two by the cephalotribe. All of the mothers recovered. It is generally considered, however, that in face presentation the prognosis for the mother is also somewhat more unfavourable than in vertex presentation, but the difference is not nearly so great as in the case of the child. In reference both to mothers and children, it is to be remembered that the pelvis is more often contracted in face than in vertex presentation.

Brow presentation.—It has already been mentioned that brow presentation constitutes the position of unstable equilibrium, in which the two arms of the head-lever exactly balance each other, so that the propulsive force has no tendency to produce either flexion or extension (see p. 228). The prominence of the forehead forms the centre of the presenting part, and the anterior fontanelle can generally be reached in one direction, the nose or even the chin in the other. The large mento-occipital, or even the maximum vertico-mental (see p. 88) diameter of the head, is thrown almost exactly across the pelvis. This is generally too large for the pelvis to admit, and hence it is usually only when the head has not yet fully entered the brim that brow presentation is observed. In the unstable equilibrium of brow presentation, if there is the slightest variation either in the degree of flexion of the head or in the inclination of the propulsive force, the tendency either to extension or flexion will begin to predominate. Hence the head can never possibly pass through the genital canal in a position of brow presentation, even if the pelvis is large enough to admit the maximum vertico-mental diameter of the head. Almost always the change is into face presentation, since the cause, whatever it may be, which has already produced undue extension, generally goes on to produce complete extension into face presentation. I have known a case however in which the presentation was partially converted into a face, and the chin rotated forward. The vertex then came down, and the head was delivered in the occipito-posterior position of the vertex. But though the head never passes through the pelvis in a position of brow presentation, it is sometimes, although rarely, arrested in that position, any slight advantage which one or other arm of the head-lever may gain at any time not being sufficient to overcome friction and move the head. Out of 49,145 deliveries in the Guy's Hospital Lying-in Charity brow presentation was observed in thirty cases. Of these twenty-five were delivered spontaneously, the presentation being generally converted into a face; three children were delivered by version, two by forceps. Thus the proportion of brow presentation was one in 1,638. But it is clear that every case of face presentation must have passed through the stage of brow presentation, if the fœtus was originally in its normal attitude. The exceptions to this are generally those cases in which there is some deformity of the fœtus, such as enlarged thyroid, producing abnormal extension.

Moulding of the head in brow presentation.—The general character of the moulding produced in brow presentation is an exaggeration of that seen in face presentation (Fig. 105, p. 237). In brow presentation the whole of the forehead (from F to B, Fig. 105) becomes more convex and prominent, instead of merely its anterior part. The flattening of the parietal bones along the line of the sagittal suture, from B to O, is carried much further than that shown in Fig. 105, and so also is the prominence and convexity near the occipital protuberance. A large caput succedaneum is generally formed, having its centre near the prominence of the forehead.

Treatment of face presentations.—The first point to be regarded is to keep the membranes intact as long as possible. The reason for this is, first, that the face does not form so good a dilator of the soft parts as the vertex; and, secondly, that it is more liable than the vertex to injurious results from pressure. Most frequently, however, face presentation is only discovered after rupture of the membranes.

In the latter stage, the general principle is to leave the case as much as possible to nature, and to be content to allow the labour to be more protracted than in vertex presentation. It was formerly recommended either to perform version, or to attempt to convert the face into a vertex presentation. To the latter plan it is a great objection that if the attempt only partially succeeds, as is very probable, the head is brought into the more unfavourable position of brow presentation. That interference is generally quite unnecessary is proved by the statistics of the Guy's Hospital Lying-in Charity already quoted, in which nearly 96 per cent. of the cases were terminated naturally. This is a larger proportion than, in the present day, is generally allowed to be terminated without assistance in vertex presentation.

Before the rupture of the membranes, indeed, an attempt may safely be made to rectify the position of the child by external manipulation, if its exact position can be positively made out, and especially if the occiput can be felt above the brim. In face presentation the chest is thrown forward against the uterine wall, while the shoulders are separated from it, at the opposite side of the uterus, by a space posterior to the child. The method to adopt, therefore, is to press with the fingers of one hand through the abdominal and uterine walls upon the chest, directing it towards the back of the child, and somewhat upwards as regards the uterine axis, until the shoulders and back are brought against the uterine wall, and the head thereby necessarily flexed. At the same time, the other hand makes counter-pressure upon the occiput, felt above the brim, directing it toward the front of the child and downward. Schatz* recommends the counter-pressure to be made upon the breech, directing it toward the front of the child, but such pressure would, if anything, tend to lower the chin rather than to raise it. This method of replacement is likely to be practicable only if the chin is directed forward or to one side, not if it is directed much backward, because then the surface of the uterus corresponding to the chest of the child cannot be reached.

Management of mento-posterior positions.—The management of mento-posterior positions precisely corresponds mechanically to that of occipito-posterior positions of the vertex. If the rotation forward of the chin does not readily take place, it is to be aided indirectly by promoting extension, just as the rotation of the occiput forward is aided by promoting flexion. This is to be done chiefly by pressing the forehead upward and somewhat backward *during a pain.* From time to time also, the chin may be drawn downward and somewhat forward by two fingers hooked over it *in the interval of pains.*

Extension may also be favoured by placing the woman on her *left* side in the first and fourth positions, when the child's back is toward the left, and on her *right* side, in the second and third positions, when the back is toward the right. For suppose the child in the second or right fronto-anterior position of the face (see Fig. 99, p. 227), and the woman placed on her right side. The breech tends to fall over toward the right, and the expulsive force therefore becomes directed somewhat obliquely toward the anterior end of the head-lever, and toward the left side of the mother. Thus the anterior arm of the head-lever is shortened, and the posterior increased. This increases the mechanical advantage which the resistance to the forehead has over the resistance to the chin (see Fig. 100, p. 228). Another plan may be tried before recourse is had to instrumental delivery. The whole hand is introduced into the vagina, the fingers on one side of the face, the thumb on the other. The head is thus grasped and so rotated.

Treatment of protracted labour in face presentation.—If the chin is directed forward, forceps may be applied without hesitation if there is indication for their use. If, however, the chin is directed backward or to one side, there is the disadvantage that one blade is apt to compress the larynx or trachea, and the child's life is then likely to be sacrificed. Under the circumstances, therefore, more patience should be exercised than in vertex presentations. The fœtal heart should be carefully watched, but instrumental aid should only be given when there is evidence that the child is likely soon to die, or when the mother's condition calls for early delivery. If the interference becomes necessary while the head is high in the pelvis, and the uterus is not firmly contracted, version may be chosen in preference to the use of forceps, especially if there is any contraction of the conjugate diameter of the pelvis. Otherwise extraction by forceps may be tried, and if this fails, craniotomy must be performed, unless symphysiotomy should be chosen by an experienced operator, to save the life of the child. The mode of carrying out these operations in face presentation will be described in Chapters XXXIII., XXXV. In rare cases, when the hand is passed up with a view to performing version, it may be found that the face presentation can easily be transformed into a vertex by hooking down the occiput with the fingers. At the same time, the external hand may assist by pushing the chest of the child through the abdominal wall in the direction of its back. The labour may then be terminated, if necessary, by the forceps.

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* "Die Umwandlung von Gesichtslage." Arch. für Gynak. B. V., p. 313.

Treatment of brow presentation.—Since by far the greater number of brow presentations end spontaneously by conversion into face presentation, the physician may exercise a fair amount of patience, to see what nature will do, so long as the mother's condition is satisfactory, and the fœtal heart beating naturally. As in the case of face presentation, extension will be aided if the woman is placed on that side toward which the *back* of the child is directed; for the breech will fall over toward that side, the propelling force will be directed somewhat obliquely toward the front of the child, and so the anterior arm of the head-lever (see Fig. 100, p. 228) will be shortened, and the posterior arm lengthened.

The conversion will fail only when the advance of the head is arrested. When it is so arrested, extraction by forceps may be tried. As in face presentations, the most favourable case for their use is that in which the chin is directed forward. In some cases, it may be possible to convert the case into one of vertex, or of face presentation, by drawing down the occiput or the chin by fingers or vectis; or if the head is high up, and the uterus not firmly contracted, version may be performed. Failing success by one or other of these means, the only resource is craniotomy.

CHAPTER XV.

PELVIC PRESENTATIONS.

In pelvic presentations the long axis of the child lies nearly in the axis of the uterus, as in head presentations, but the head is directed upwards instead of downwards. The primary form of pelvic presentations, and that which is most frequently observed, is *breech presentation.* In this the attitude of the child is generally the same as in vertex presentation, all the limbs being flexed, and the feet close to the breech, or buttocks, which form the presenting part (see Fig. 106). It is much more common, however, than in vertex presentation for the legs to be more or less extended on the

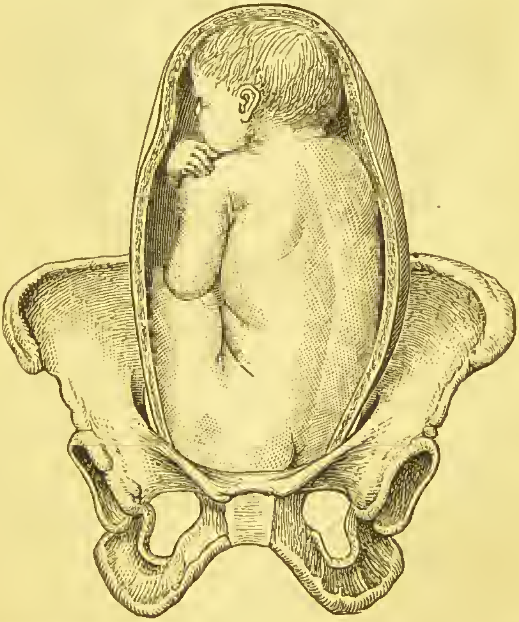

Fig. 106.—First, or left sacro-anterior, position of the breech.

thighs, because there is not so much space for the legs in addition to the breech in the lower segment of the uterus as there is at the fundus. (See Fig. 107.) Sometimes one or both thighs become extended on the trunk after rupture of the membranes, or when the bag of membranes is bulging through the os, either from the gush of liquor amnii, or from active movement of the child. In this way is developed out of breech presentation a presentation of one or both knees (very rare), of one or both feet, or of a knee and a foot. This extension of thigh is more likely to occur when the breech does not so fully occupy the lower segment of the uterus, and when the liquor amnii is relatively abundant. Hence foot or knee presentations, compared with breech presentations, are relatively more frequent with premature children and twins. When the long axis of the child is oblique in the uterus, the breech being lower, one or both feet may present at the os before rupture of the membranes, and the hands may then sometimes be felt also. The frequency of pelvic presentation is estimated at from 1 in 60 to 1 in 45 for mature children, and at about 1 in 30 including all cases. Breech presentations form about 60 or 65 per cent. of all pelvic presentations. The statistics of Guy's Hospital Lying-in Charity give—pelvic presentations 1 in 38, breech presentations 1 in 58, foot or knee

Cause.
(1) Failure of forces
(2) Premature childr
(3) Twins
(4) Placenta Previa
(5) Hydrocephalic ch.
(6) Excess Liq. Amn
(7) Dead Children
(8) Contracted pelvis

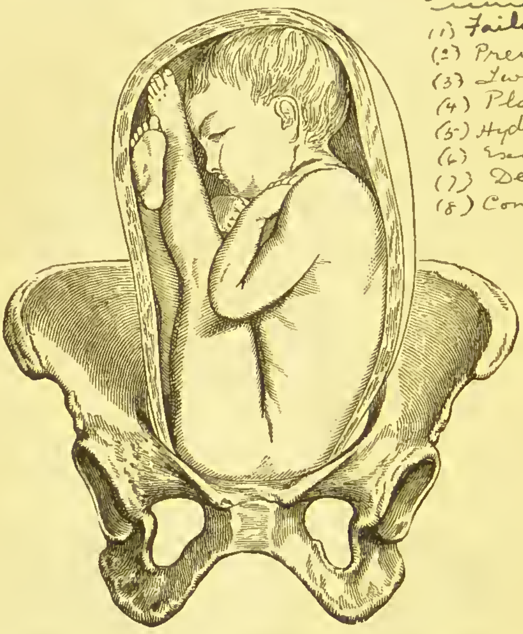

Fig. 107.—Breech presentation with extended legs.

presentations 1 in 121, breech presentations forming about 68 per cent. of all pelvic presentations.

Causation of pelvic presentation.—The causation may depend on anything which leads to the failure of the forces which generally produce head presentation (see p. 97). Since the adaptation of the child to the shape of the uterus is progressively greater as pregnancy advances, pelvic presentation is commoner with premature children. It is also commoner with twins, in cases of placenta prævia, with hydrocephalic children (see Fig. 61, p. 99), with excess of liquor amnii, with dead children, or with contraction of the pelvis, which prevents the fixation of the head in its normal position. In the case of dead children the effect is chiefly due to the failure of active movements, which aid in adapting the position to the shape of the uterus (see p. 100), but the less relative specific gravity of the head in dead children has also been considered to have an influence. Pelvic presentation is also promoted by laxity of the walls of the uterus or abdomen, and is therefore relatively commoner in multiparæ.

Varieties of breech presentation.—There are four positions in breech presentations, corresponding to the four positions of the vertex. The dorso-anterior positions are the commoner, like the occipito-anterior positions of the vertex, and, like them also, differ in the mechanism of their delivery from the dorso-posterior. There is one difference, namely, that in the case of the breech, the transverse or bis-iliac diameter, and not the antero-posterior, is the longest, and tends to adapt itself to the longest diameter of the pelvis.

First or left sacro-anterior (*L. S. A.*).—The sacrum looks toward the left foramen ovale; the bis-iliac diameter approximates toward the left oblique diameter of the pelvis.

Second or right sacro-anterior (*R. S. A.*).—The sacrum looks toward the right foramen ovale; the bis-iliac diameter approximates toward the right oblique diameter of the pelvis.

Third or right sacro-posterior (*R. S. P.*).—The sacrum looks toward the right sacro-iliac synchondrosis; the bis-iliac diameter approximates toward the left oblique diameter of the pelvis.

Fourth or left sacro-posterior (*L. S. P.*).—The sacrum looks toward the left sacro-iliac synchondrosis; the bis-iliac diameter approximates toward the right oblique diameter of the pelvis.

In each of these positions, assuming the position of the head to be adapted to that of the trunk, the front and back of the head look in the same directions as in the corresponding positions of the vertex or face. The first position of the breech, as of the vertex, is the commonest. This is due to the same cause. Owing to the usual right torsion of the uterus (see p. 174), the large transverse diameter of the uterus approximates toward the right oblique diameter of the pelvis, and the large antero-posterior diameter of the whole ovum most readily accommodates itself to this, the back turning away from the prominent lumbo-sacral curve of the mother, and so becoming anterior. This frequency of the first position in breech presentation is a proof that the position depends at least as much upon the accommodation of the whole ovum as upon that of the presenting part in the pelvis, since the long diameter of the presenting part now occupies the *left* oblique diameter of the pelvis, which is encroached upon by the rectum and sigmoid flexure. Foot or knee presentation may arise out of any of the varieties of breech presentation.

Diagnosis.—On abdominal examination the round, smooth mass of the head may be made out at the upper part of the uterus. Unless the legs are extended, the fundus uteri is less broad than usual, the lower segment broader. The fœtal heart is heard most distinctly higher up than in vertex presentation, generally about the level of the umbilicus. A sign is given for diagnosing extension of the legs before the onset of labour, namely, that, in this case, the fœtal heart is heard lower down than is usual in pelvic presentation, because the breech, not being enlarged by the addition of the legs, is able to lie lower in the pelvis. The bag of membranes is apt to be large and descend low, while the presenting part still remains high. In foot presentations the bag is especially elongated. Before rupture of the membranes, the double contour of the buttocks and the prominences along the sacrum may be felt; and sometimes the feet may be felt near the breech. When the membranes rupture the liquor amnii escapes gradually, but more completely than in vertex presentations, the flow not being stopped by the action of the head as a ball-valve. The pains after rupture are apt to be more frequent than in vertex presentations, the complete escape of liquor amnii allowing the uterine wall to come into closer contact with the fœtus. After rupture of the membranes in breech presentation, the os uteri, on vaginal examination, is found to be occupied by two smooth elastic swellings, the buttocks, on which no tangible hair, like that on the scalp, can be felt. The cleft between the buttocks can be traced backwards to the coccyx and sacrum, and in its course can be felt the anus, which, in a living child, contracts on the finger if an attempt be made at introduction. Thick tenacious meconium comes away on the finger, unlike that mixed with liquor amnii, which may be expelled in head presentations when the child has undergone severe pressure. The genitals may also be recognised, and in the male the scrotum, which becomes much swollen, is a marked feature. The differential diagnosis of the breech from the face, the only part likely to be mistaken for it, has been already mentioned (see p. 238).

The knee is distinguished from the elbow by being broader, and having, besides the patella, two tuberosities with a slight depression between them in place of the sharp projection of the olecranon. In case of the slightest doubt, after rupture of the membranes, the diagnosis should be verified by bringing down the foot. The foot is liable to be confused with the hand when, before rupture of the membranes, it is only just reached with the tip of the finger. The following are the characteristic differences. The toes form an even line and are not very moveable, while the fingers are more irregular and divergent. The great toe lies close to the other toes, while the thumb is inclined at an angle to the hand, and is opposed to the other digits. The hand of a living child will often grasp the examining finger. The most unmistakeable point of all about the foot is the projection of the heel, with the malleoli above it. This is most easily felt with absolute certainty by catching the foot between two fingers, or between the fingers and thumb, as may usually be done without rupturing the membranes if they are still intact, and still more easily after the escape of the liquor amnii. In case of doubt whether foot or hand is presenting, as it is important to make the diagnosis early, it is desirable, if necessary, to introduce half, or even the whole hand into the vagina, in order to reach high enough to seize the foot in this way. By this method it is easy to avoid any risk of mistake between the heel and the elbow, which may be confused if touched only with the tip of the finger.

Mechanism of labour in breech presentation.—The bis-iliac diameter of the breech enters the pelvis, as already mentioned, nearly in one of its oblique diameters. There is no movement corresponding to flexion in vertex presentation. As the breech descends an *internal rotation* occurs, similar to the internal rotation of head presentations, the bis-iliac diameter turning nearly into the antero-posterior diameter at the outlet (see Fig. 108, p. 248). Thus, in the first position of the breech, the sacrum turns from the left foramen ovale toward the left side of the pelvis, and the left hip comes under the pubic arch. This internal rotation is not generally so complete as in head presentations, especially when space is ample, the breech being less firm and incompressible than the head.

Corresponding to the *extension* in occipito-anterior positions of the vertex is a *lateral flexion* of the breech on the trunk, due to the inclined plane of the soft parts of the pelvic floor pushing the forecoming part of the breech forward while the trunk is held backward by the resistance of the pubes (see Fig. 108). The anterior buttock thus comes under the pubic arch, while the posterior buttock distends the perineum. Combined with this lateral flexion is a slight posterior flexion of the breech on the trunk in dorso-anterior positions, and anterior flexion in dorso-posterior positions.

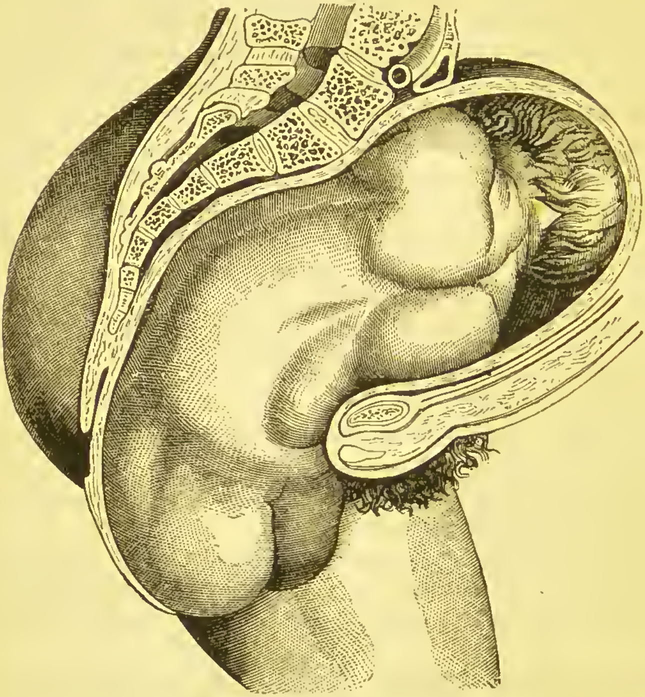

Fig. 108.—Passage of breech under pubic arch by a movement of lateral flexion (second position).

These are analogous to the lateral flexion of the head toward the anterior shoulder near the outlet of the genital canal in head presentations, and are due to a similar cause. The anterior buttock is the first to appear at the vulva, and the first to be delivered, provided that the perineum is intact (see Fig. 108). When the perineum is deficient, the posterior buttock may be the first to escape.*

After the buttocks have escaped from the vulva, there is a slight

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* It is sometimes stated that the rule is for the posterior buttock to be born first, but this only occurs when there is deficiency of the posterior wall of the genital canal from former rupture of the perineum.

external rotation in the reverse direction to the internal rotation, the breech returning toward the oblique diameter which it originally occupied, so as to accommodate itself to the position of the shoulders, which are entering the pelvis in the oblique diameter. left This is not so marked as in head presentation. The feet escape close to the buttocks, unless the legs are extended, the thighs are delivered soon after, and the abdomen descends. Provided no traction has been made upon the child, the arms generally emerge, folded upon the chest, before the shoulders. As the shoulders approach the outlet, the bis-acromial diameter, like the bis-iliac, turns nearly into the antero-posterior diameter of the outlet (Fig. 109).

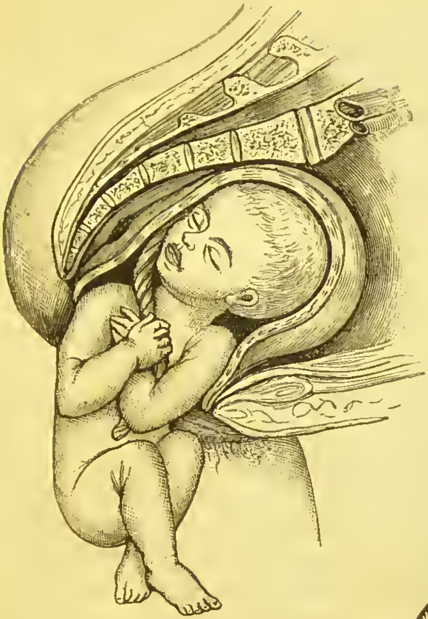

Fig. 109.—Passage of the shoulders in pelvic presentation (first position).

The head enters the pelvis in the right oblique or nearly in the transverse diameter, and is maintained in a position of flexion by the pressure of the uterus upon it so long as no traction is made upon the child. As in head-first deliveries, the long diameter of the head turns nearly into the antero-posterior diameter of the outlet, so that the occiput escapes under the pubic arch (Fig. 111, p. 250). As soon as the head has been expelled out of

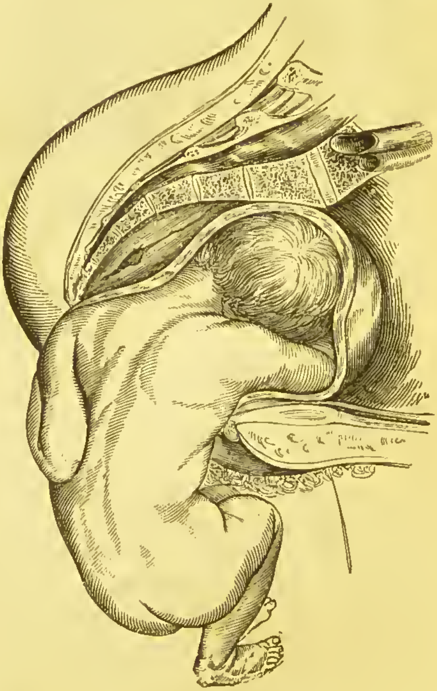

Fig. 110.—Passage of the shoulders in pelvic presentation, one arm extended (second position).

the powerfully contracting body of the uterus into the distended cervix and vagina, the expulsive force necessarily acts at a great disadvantage (see Fig. 111). The only force which then comes into play is that of the auxiliary muscles and the feeble contractile powers of the vagina and cervix. Hence the head is apt to be delayed at this stage, and the fœtus to die from asphyxia. But generally expulsion is effected chiefly by the action of the abdominal muscles, strongly stimulated by the presence of the large hard head in the vagina. If delivery thus takes place naturally, flexion of the chin is maintained to the last, the chin and face emerging first, and the occiput last. In the second position of the breech, the mechanism is precisely the same as in the first, right and left being interchanged.

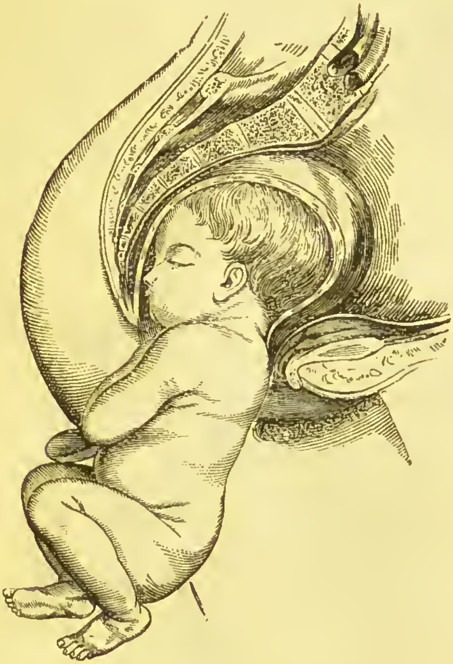
Fig. 111.—Descent of the head.

Mechanism in dorso-posterior positions of the breech.—Suppose the child to be in the third position of the breech, the sacrum looking toward the right sacro-iliac synchondrosis. The sacrum in this case rotates forward instead of backward, so that the right or anterior buttock rotates forward under the pubic arch. The buttocks are then delivered by lateral flexion in the same way as in sacro-anterior positions. If the bis-iliac diameter has rotated completely into the antero-posterior diameter of the pelvis, the external rotation of the breech is generally continued on in the same direction as the internal rotation, and not reversed. The bis-acromial diameter of the shoulders thus enters the brim in the right oblique diameter instead of following the bis-iliac in the left oblique. The long diameter of the head enters the brim with the occiput somewhat forward, and labour is completed as in the second position of the breech. The only explanation which can be given for this is the general tendency of the spine of the child to rotate forward away from the spine of the mother. Sometimes, however, especially if the internal rotation of the breech has been incomplete, there is an external rotation in the reverse direction, and the bisacromial diameter enters the brim in the left oblique, rotating into the antero-posterior, or nearly so, as it descends. The head then enters the brim with the occiput directed laterally or a little backward. As it descends the occiput almost always rotates forwards under the pubic arch. The cause of this movement is that the neck, which is attached to the posterior part of the head, meeting the resistance of the inclined plane of the pelvic floor, turns away from it into the free space under the pubic arch. N. 1

Irregularities of mechanism.—In rare cases of dorso-posterior position, the occiput remains posterior, turning somewhat toward the hollow of the sacrum. This is most likely to happen when space is ample, so that little or no internal rotation of the buttocks or shoulders occurs, and the back continues to look toward the sacrum during the passage of the trunk. The head may then still be delivered in a position of flexion, the chin and face first escaping under the pubes, and the occiput finally passing over the perineum. Cases have been recorded of a much more rare occurrence, namely, that the head becomes extended into a position like that of face presentation, the face looking upward toward the abdomen, while the occiput is pressed down upon the back. The occiput is then said to emerge first over the perineum, while the chin is delayed behind the pubes, and the face is born last. But, in such a position, the head is arrested, unless very small in proportion to the pelvis.

Mechanism in foot or knee presentation.—If one thigh only is extended, the extended thigh forms the most advanced part of the fœtus, is the first to meet the resistance of the inclined plane of the pelvic floor, and therefore, according to the universal rule, turns forward away from the resistance into the free space under the pubic arch. Therefore the buttock, corresponding to the extended thigh, becomes eventually anterior. The delivery of the body and head is the same as in breech presentations.

Moulding of the child in pelvic presentation.—The œdematous swelling, corresponding to the caput succedaneum, occupies mainly the anterior buttock, and includes the genitals, especially the scrotum in a male. The absence of any caput succedaneum on the head is notable. The shape of the head is little altered, but it becomes somewhat more rounded than the head before moulding, the vertical, or cervico-bregmatic diameter being relatively increased. This is due to the pressure of the genital canal on the front, back, and sides being more continuous than the uterine pressure on the top of the head.

Prognosis.—The prognosis is not more unfavourable for the mother than in vertex presentations. The first stage of labour is generally more tedious, since the breech is not so well shaped a dilator as the head, and, from its softness, does not stimulate the nerves of the cervix so powerfully. The passage of the head is also apt to be delayed, the breech not being large enough to dilate the passages sufficiently to allow it to pass with ease. If one foot or knee present, and, still more, if both do so, the likelihood of delay is greater, the fore-coming part of the fœtus being then a more inefficient dilator than the breech.

In this way arises the great danger to the child's life in pelvic presentations. One cause of this is pressure on the funis. This begins in some measure as soon as the umbilicus is entering the brim, that is, when the buttocks are passing the vulva (see Fig. 108, p. 248), but is much greater when the trunk is born, and the funis is compressed between the hard head and the pelvis. A still more important cause is, that by the shrinking of the uterus on the expulsion of the main part of the bulk of the fœtus the placenta is more or less completely detached. This is especially the case when the head is completely expelled out of the body of the uterus into the cervix and vagina (see Fig. 113, p. 255). A comparatively short delay at this stage is therefore inevitably fatal to the child.

The proportion of children still-born varies very much according to the skill of the accoucheur, and therefore is very differently estimated by different authors. Churchill gives the mortality as 1 in $3\frac{1}{5}$, Dubois as 1 in 11. The statistics of the Guy's Hospital Lying-in Charity, where the labours are attended by students, and where the child is often born before the arrival of the accoucheur, give a still higher mortality than that estimated by Churchill, namely 1 in 3·0 for breech presentation, and 1 in 2·3 for foot or knee presentation, out of 49,145 deliveries.

Management of pelvic presentations.—The first and most essential point in the management of pelvic presentations is to abstain from premature interference with nature. In the first instance the membranes must be kept intact as long as possible, in order to get the greatest possible dilatation of the soft parts by their means, since the breech forms an inefficient dilator to prepare the way for the larger-sized head which has to follow it. In presentation of one or both feet, this necessity is still greater, since the half-breech, or both legs together, form a still worse dilator than the breech.

After rupture of the membranes, it is still necessary to leave matters to nature as long as possible. The midwife or inexperienced student may be tempted by the facility for traction which is offered by the body or legs of the child, especially if the labour proves tedious. But if any traction is made prematurely, two evil results follow. First, the arms, instead of remaining folded on the breast and slipping out before the head, are retarded by friction. They then slip up by the sides of the head, and become jammed with the head in the pelvis, thus frequently causing the loss of the child's life. Secondly, the tractile force being transmitted through the neck, the anterior arm of the head-lever is the longest; the resistance which it meets has therefore the mechanical advantage over that experienced by the posterior or occipital arm, and the head becomes extended. In this way the maximum vertico-mental diameter of the head may be thrown across the pelvic brim, or nearly so, and find the space insufficient for its passage.

The first pressure upon the funis, and consequent risk to the child, begins when the umbilicus enters the pelvic brim, or about the time when the breech is passing the vulva, but it becomes much greater when the child is born as far as the umbilicus. It is just before this time that the first duty of the attendant commences. As soon as he can easily reach the umbilicus by passing a finger just within the vagina, he should draw a loop of the cord gently downward. The object of this is twofold—first, to prevent the cord undergoing any longitudinal stretching as the child advances, and consequent interference with the circulation through its spiral vessels; secondly, to enable him to watch the fœtal pulsations in the cord, and so judge of any danger to the fœtus. The loop of cord should also be guided to that part of the pelvis where there is most room for it, generally opposite the sacro-iliac synchondrosis.

From this time the delivery may be accelerated so far as this can be done by encouraging the patient to bear down, and by pressure from above the fundus. But still there must be no further interference, unless there are signs that the child is in imminent peril. The most significant of these are inspiratory efforts, made while the mouth and nose are still retained within the passages. These are evidence that the child is becoming suffocated. Failure, or great retardation, of the pulsation of the funis is also an indication that it is necessary to have recourse to extraction.

As the breech and body of the child are passing the vulva the physician should, with his right hand, support the body, and carry it forward between the mother's thighs towards her abdomen, thus aiding the lateral flexion of its body (see p. 248). At the same time he should assist the expulsion by pressing with his left hand upon the fundus uteri. Such external pressure is of special value, because, while aiding the expulsive force, it also promotes the flexion of the head, and tends to keep the arms in their natural position across the chest. In most cases it will prevent the necessity for having recourse to artificial extraction. After the arms have appeared, and when the head is reaching the vulva, it is better to hand over to the nurse, or other assistant, the duty of pressing upon the fundus, and spread out the left hand behind the perineum, in front of the sacro-sciatic ligaments, in the same position as that described at p. 215 for the case of the fore-coming head. By pressure in this situation, the finger and thumb keep the head forward under the pubic arch, and so tend to avert rupture of the perineum, while at the same time, by pressure upon the forehead at the final stage of expulsion, they may assist the exit of the head. Both objects may also be attained by passing two fingers into the rectum through the dilated anus (see p. 215); and, if the head is delayed just at the final stage of passage, this method may have the advantage.

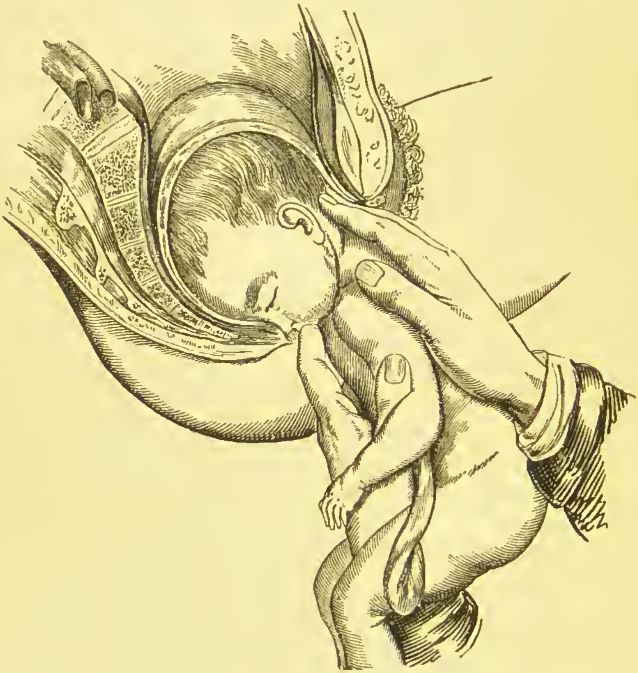

Fig. 112.—Mode of extraction of the head formerly recommended.
(After Tyler Smith.)

Extraction of the head.—When the after-coming head is expelled out of the strong contractile body of the uterus into the dilated cervix and vagina (see Fig. 113, p. 255), the natural forces act upon it at a very great disadvantage. For the only expelling forces are now the weak contractile powers of the cervix and vagina and the action of the auxiliary muscles. Hence at this stage sufficient delay to cause the death of the child is apt to be produced, if the case is left to nature. As soon, therefore, as the arms have escaped, the head should be extracted if it does not immediately follow.

At this stage the resistance is due only to the soft parts of the vaginal and vulval outlet, and is usually not considerable. There is, however, one mechanical difficulty in artificial extraction. The force of traction, acting through the spinal column, is applied to the head at a point nearer to its posterior than to its anterior extremity. Hence, if traction is made in the axis of that plane of the genital canal in which the centre of the head lies (see Fig. 16, p. 18), the occiput is drawn down more than the forehead, the head becomes extended, a larger diameter of it is thrown across the genital canal, and in consequence the resistance is greatly increased, and the perineum is endangered.

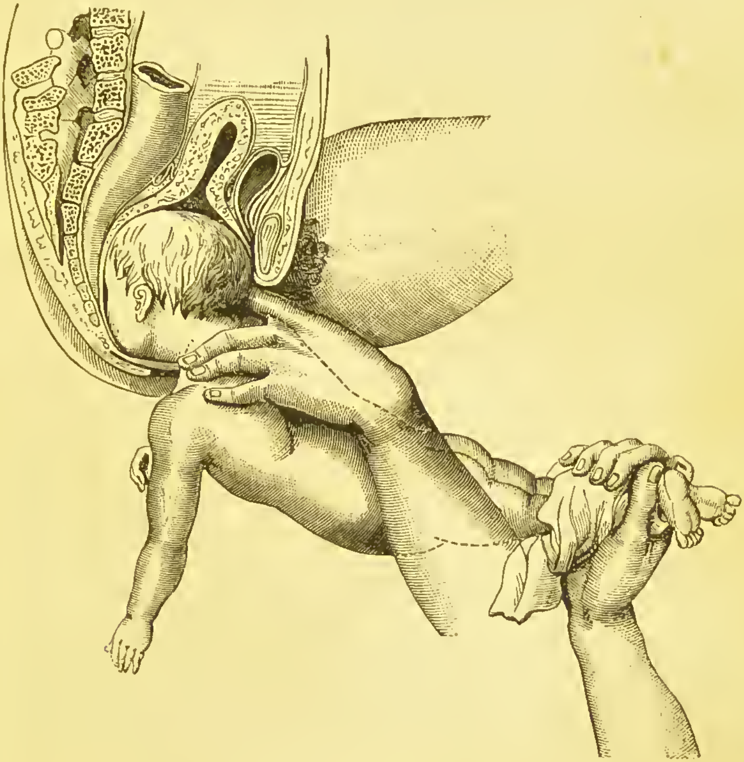

Fig. 113.—Manual extraction of head through the outlet of soft parts.

Hence the object to be attained is to make traction in such a way as to avoid causing extension, and secure the descent of the chin. In order to effect this it was formerly recommended to place the right hand behind the child's back in the position shown in Fig. 112, p. 254, pushing up the occiput, and either to place two fingers of the left hand on the child's malar bones or to hook a finger into its mouth. The position altogether does not give a firm enough grasp for any vigorous traction, especially if the right hand is to be employed in pushing the occiput up. The fingers on the malar bones give a very slight hold, since they keep their place only by friction. A finger in the mouth is indeed more effective. But the introduction of the finger increases the stretching of the perineum, and traction on the lower maxilla sufficient to secure flexion is apt so far to strain the lower jaw that it may impair the infant's power of sucking with comfort. It is better, therefore, not to employ it when other means are available.

A far more effective method of securing the descent of the chin is to incline the direction of traction *forwards* in reference to the axis of that plane of the genital canal in which the centre of the head is lying. The mode of doing this is shown in Fig. 113, p. 255. The proceeding is as follows: Wrap the legs and feet of the child in a napkin and seize them with the right hand. Hook the left hand over the back of the neck, as shown in the figure. Then carry the legs forward in a direction almost, but not quite, at right angles to the pubes, as indicated in the figure. Make traction in this direction with the right hand. Aid the traction with the left hand, but use this hand chiefly to steady the head, and prevent its escaping with too sudden a jerk.

The explanation of the success of this method is as follows: The forward direction of the traction causes a pressure of the pubes against the occiput. This force, combined with the component of the tractile force resolved perpendicularly to the pubes, and acting through the condyles, forms a "couple," or pair of equal and opposite forces not acting in the same straight line, which tends to cause descent of the chin and ascent of the occiput.

In a parous woman this method will almost always instantly release the head when once it has reached the pelvic floor. The only difficulty likely to occur is in a primipara, to whom, with a fore-coming head, rupture of the perineum would be likely to occur. But it is necessary to risk the perineum in order to save the child's life. If, therefore, the method above described does not quickly succeed, the left hand may be removed from the neck. The right hand may make sufficient traction, and the left hand aid by squeezing out the head, either by pressure just in front of the sacro-sciatic ligaments, or through the recto-vaginal septum upon the face or forehead, two fingers being passed into the anus. If this still fails, the index finger of the left hand may be passed into the vagina, and placed on the edge of the lower maxilla. Jaw-traction may then be made in the same way as in extracting the head through a contracted pelvis. (See Chapter XXIX.) This is very effective both in causing flexion, and in adding to the tractile force without increasing the tension upon the neck, but it is very rarely required to overcome resistance due only to the soft parts.

CHAPTER XVI.

MULTIPLE PREGNANCY.

By multiple pregnancy is meant the simultaneous development of more than one embryo. The case of chief practical importance is that of twin pregnancy, which occurs, taking an average for different countries, about once in eighty cases. Triplets are found only about once in 6,000 pregnancies. It is extremely rare to find a greater number of embryos than three, but instances are on record in which there have been as many as five.

Causation.—The proportion of twin pregnancies varies in different countries, and it may be inferred that the variation depends upon difference of race. On the whole, multiple pregnancy appears to be commonest among the most fertile races. Thus in Ireland the proportion is about one in 60, in England only about one in 110. Individual women occasionally show a tendency to repeated twin pregnancy, and there is evidence that this tendency may be hereditary. Such constitutional or hereditary tendency shows itself, as a rule, on the mother's side, but there is some reason for believing that the father may also have an influence, for an unusual number of twin pregnancies have sometimes occurred in the families of brothers, or in those of the same husband by different wives. According to the statistics collected by Matthews Duncan,* the tendency to production of twins increases with successive pregnancies, with the exception of the first pregnancy, at which it is greatest of all; and the later in life women are married, the more likely are twins to be born at the first delivery. It has generally been considered that the tendency to produce twins is associated with unusual fertility, but Matthews Duncan,† from observations on animals, infers that the birth of twins may be a stage on the way toward sterility.

Multiple pregnancy may arise in one of three ways:—1. Two or more ova may become fertilised at the same time. These may proceed either from the same or different ovaries, and, in some cases, may both escape from the same Graafian follicle. The possibility of two ova being thus fertilised at the same time is proved by the finding, in some cases, of two corpora lutea equally developed, and by the occasional occurrence of simultaneous pregnancy on the two sides of a double uterus, also by that of twin pregnancy with one fœtus in the uterus and one extra-uterine.

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* "On Fecundity, Fertility, and Sterility."

† "On Sterility in Woman." London, 1884.

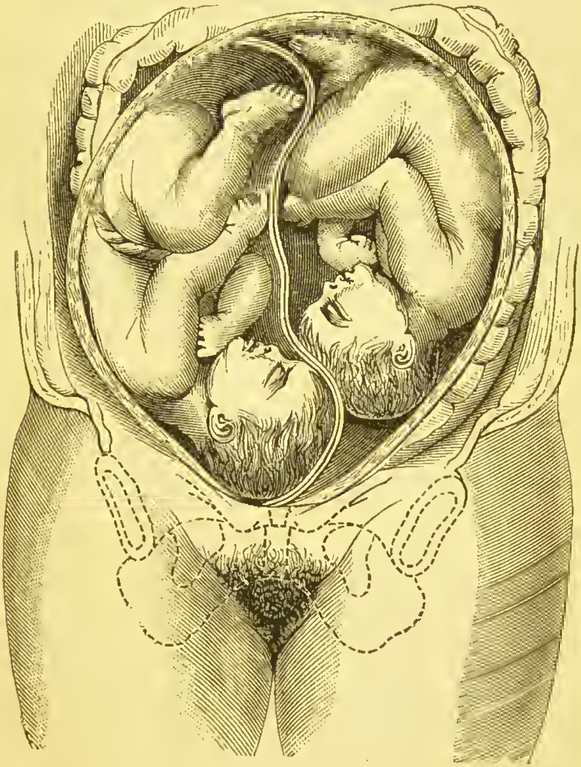

Fig. 114.—Twins *in utero*, both presenting by vertex.

It is probable that both ova may be fertilised at the same coitus, but this is not always the case. This is proved by the fact that sometimes children of different colours have been born, one white and one mulatto, or one mulatto and one negro. In the case of animals, it is known that different fœtuses in the same litter may have different fathers. This occurrence is called *superfecundation.*

When the twins arise from two different ova, each will be enclosed in its own amnion and chorion, and, in the first instance, its own decidua reflexa. When the growing ova come into contact, and a partition between them is formed by the union of their walls, the decidua reflexa may soon become thinned and lost in the partition. Only four layers, instead of six, are then traceable in the partition, two of chorion and two of amnion. The placentæ may be entirely separate, or they may be joined at their borders or united by a membranous portion, but there is no vascular communication between them. From the fact that two distinct bags of membranes are most frequently found (in about 85 per cent. of all cases), it appears that this variety of twin pregnancy is the commonest.

2. An ovum may have a double yolk, and an embryo be developed from each. In this case the placenta and chorion are common to the two, but the amniotic sacs are separate. The septum between them may, however, break down or be absorbed, and the embryos may thus come to be contained in a single bag of membranes. In this variety, there is frequently more or less vascular communication in the placenta between the two embryos. A single chorionic cavity occurs in about 12 per cent. of twin pregnancies.

3. A single area germinativa may be so divided as to give rise to two embryos. If the division is incomplete some form of double monster is the result. In the latter case only a single amniotic cavity is developed from the first, and it is probable that this may be so also when the embryos are completely separated. In this variety also there is a single placenta, and generally vascular communication between the embryos. In some cases the funis is single near its placental insertion, but contains a double set of vessels, and bifurcates on approaching the fœtuses.

This variety of twin pregnancy is much the rarest. In only about 0·8 per cent. of all cases the twins are found in a single amniotic cavity (Ahlfeld), and even from this proportion those cases have to be deducted in which a partition, originally existing, has been absorbed. It is said that twins contained in the same amniotic cavity show, in after-life, a much closer resemblance to each other than ordinary twins.

In triplets, it appears that most frequently two are developed from the same ovum, and the third from a second ovum.

Acardiac monsters.—When two embryos are contained within a common chorion, the allantois of one, instead of reaching a free space on the interior of the chorion, may blend with the allantois of the other. In this case a single placenta is formed, with an arterial vascular communication between the two embryos. When the vascular communication of umbilical arteries in the placenta is free, and one fœtus is stronger than the other, the weaker fœtus is apt to be converted into what is called an acardiac monster in the following way. Blood from the arteries of the fœtus having the stronger heart reaches the arteries of the weaker fœtus, and, by virtue of its greater tension, causes the blood to flow back to the heart, thus reversing the direction of the current. The heart of the weaker fœtus, being no longer of use, becomes atrophied. From its imperfect blood supply, this fœtus is very imperfectly developed, and generally only the lower parts of the body are developed at all, since the blood, arriving at the iliac arteries, has readiest access to these. The trunk and upper parts are represented by a mere mass of flesh (see Fig. 115). In rare cases there is a partial development of the head and upper limbs. An acardiac fœtus is thus generally also acephalic. It must be distinguished from the anencephalic fœtus, in which the base of the skull is developed, and which has nothing to do with twin pregnancy.

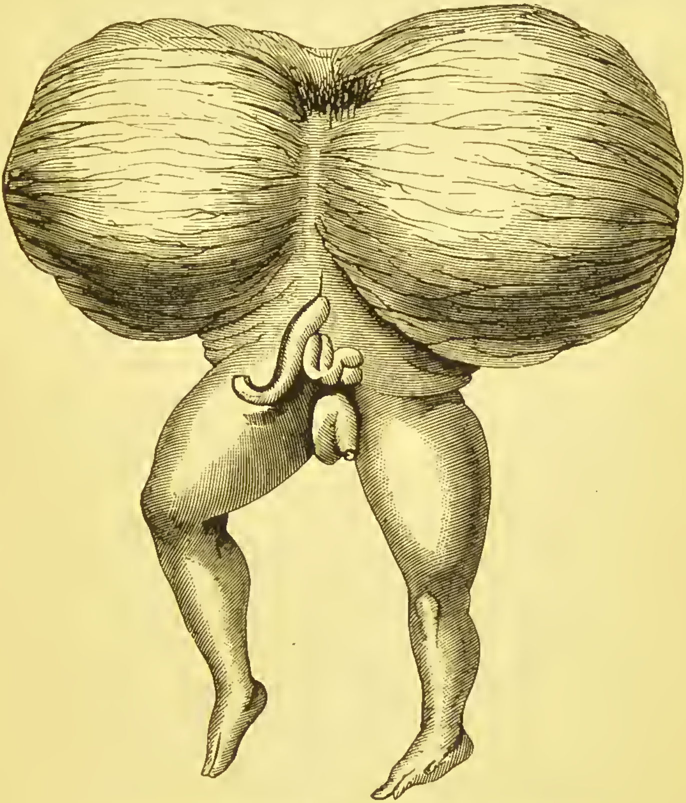

Fig. 115.—Acardiac, acephalic fœtus. (After Lusk.)

Sex of the children.—Double monsters are invariably of the same sex. It is probable that the same law may hold true of all twins developed from a single ovum, but this is not certain. A case has occurred in the Guy's Hospital Lying-in Charity of twins of the opposite sex contained in the same bag of membranes. It has even been contended by Dr. Brunton* that this is the general rule. The statistics of the Guy's Hospital Lying-in Charity give 38 per cent. as the proportion of cases in which both children were males, 34 per cent. in which there was one of each sex, 28 per cent. in which both were females. According to German statistics collected by Veit, however, it is most frequent to find one child of each sex.

Course of pregnancy in multiple gestation.—Twins, and still more triplets, are, as a rule, smaller and weaker than ordinary children, and the mortality among them is greater. In the case of triplets, it is rare for all three to survive. The uterus and abdomen, however, become more distended than in ordinary pregnancy, and this condition is apt to lead to premature labour. This is often an additional reason for the small size of twins at birth. Besides the ordinary risks during pregnancy, a twin or triplet has to incur the struggle for existence with the other fœtus or fœtuses, and if one is less favourably placed for obtaining nutriment, it is either smaller and weaker, or may perish altogether. Thus it is not uncommon for one twin to be much larger than the other at birth. When one twin dies during pregnancy it is frequently retained until full term, and then expelled with the other. Being excluded from the air, it does not become putrid, but shrinks up and becomes mummified. To such a blighted fœtus, when flattened between the other bag of membranes and the uterine wall, the name of *fœtus papyraceus* has been given. More rarely, the dead ovum, perishing at an early stage, degenerates into a mole. In other cases, the dead fœtus acts as a foreign body, and sets up uterine action. Then either the dead ovum alone may be expelled provided the bags of membranes and placenta are quite separate, or both may be expelled.

Diagnosis.—A suspicion of twin pregnancy may be excited by unusual size of the abdomen and uterus, but no certain inference can be drawn from it. If the fœtuses lie side by side, it may be possible to distinguish them separately by palpation, and special attention should be devoted to discovering whether two heads can be felt. As a rule the only certain diagnosis before labour is to distinguish two fœtal hearts, of different rapidity, heard at two distant points, the sound being lost in the intervening space. By listening with a binaural stethoscope, fitted with separate tube for each ear-piece, it may be possible positively to determine that the two hearts are asynchronous.

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* "Observations on Cases of Twins," Obst. Trans., Vol. XI.

As a rule, twin pregnancy is only discovered after the birth of the first child. The uterus is then found still large, and a second bag of membranes or part of fœtus presenting. During labour twin pregnancy may be suspected if the uterus is very large after rupture of the membranes, the presenting part small, and labour tedious from inertia of the uterus.

Presentation.—The following is the frequency of the various presentations according to the statistics of the Guy's Hospital Lying-in Charity: vertex in both, 53·6 per cent.; vertex and pelvis, 34·1 per cent.; both pelvic presentations, 10 per cent.; one transverse, 2·3 per cent. Spiegelberg's statistics show a greater frequency of transverse presentation, namely, 10·6 per cent. In Fig. 114, p. 259, is shown the adaptation of twins *in utero*, both presenting by the vertex, in Fig. 116 the adaptation with one vertex and one pelvic presentation.

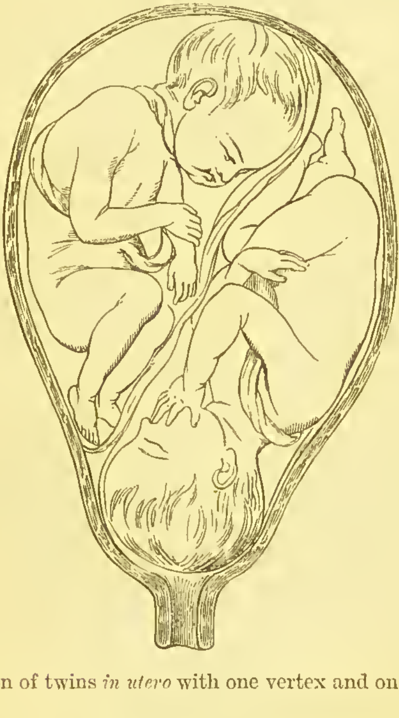

Fig. 116.—Adaptation of twins *in utero* with one vertex and one pelvic presentation.

Labour in twin pregnancy.—Labour is generally free from obstruction, on account of the small size of the children, but is apt to be tedious from inertia of the over-distended uterus.

For the same reason, there is more liability than usual to post-partum hæmorrhage. Labour is premature in about 25 per cent. of the cases. The birth of the second child is generally rapid, the passages being already dilated. In the absence of any interference, pains generally come on again within an hour or two after the birth of the first child. In rare cases the second labour does not come on till a day or two after the first. Instances are recorded in which weeks have intervened, but these may have been cases of double uterus, a condition which is easily overlooked when the body only is double, and the cervix single. Such an occurrence may give rise to an erroneous supposition of superfœtation.

The placenta, or placentæ, is generally expelled after the birth of the second child, but sometimes the first placenta, if quite separate, is expelled before the second child. It is only in such a case as this that the second child is likely to be retained for days or weeks.

Management of labour.—After the birth of the first child, the physician must take care to tie the funis on the maternal as well as on the fœtal side, in case there should be vascular communication in the placentæ. After the first birth the woman should be allowed to rest for a time. If, however, pains are not renewed within from half an hour to an hour, the second bag of membranes, if intact, should be ruptured. If the uterus is inert it should be stimulated by external pressure, which may generally be sufficiently exerted by a binder. In some cases, on this account, delivery by forceps is called for. Special care must be taken, by keeping up pressure on the uterus, to guard against the risk of post-partum hæmorrhage, and it is well to give a dose of ergot after delivery of the placenta—say one drachm of the liquid extract.

Any abnormal presentation must be treated in the usual way. The difficulties which may arise from both children descending into the pelvis together, and becoming interlocked, will be considered in Chapter XXVIII.

Superfœtation.—It has already been mentioned that by superfecundation is meant the fertilisation at a second coitus of another ovum belonging to the same period of ovulation. By *superfœtation* is meant the fertilisation of a second ovum belonging to another period of ovulation after the first ovum has been developing for a month or more. This occurrence is, of course, as a rule, impossible, because ovulation ceases during pregnancy, and eminent authorities have contended that this impossibility is absolute. Since however menstruation, in rare cases, continues during pregnancy, especially during the first three or four months, there is no valid ground for denying that ovulation may sometimes take place also. In extra-uterine pregnancy there is positive evidence that it may do so, for a five months' fœtus has been found in the abdomen, and a three

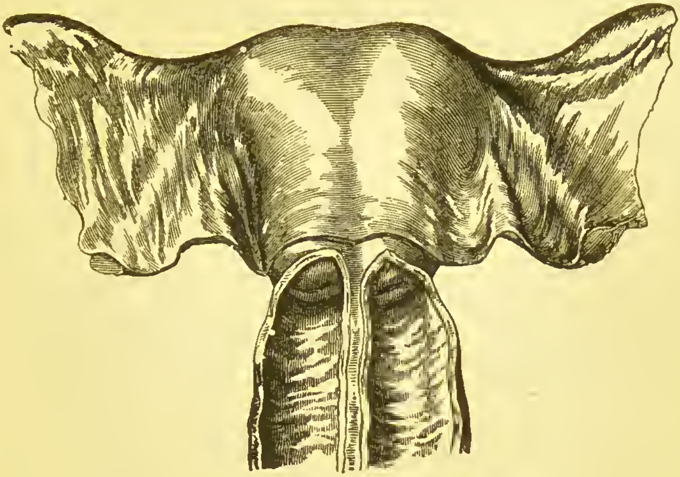

Fig. 117.—Uterus septus, vagina also double.

months' fœtus in the uterus. In this case the intra-uterine fœtus would be the better situated for getting nutriment, and its inferior

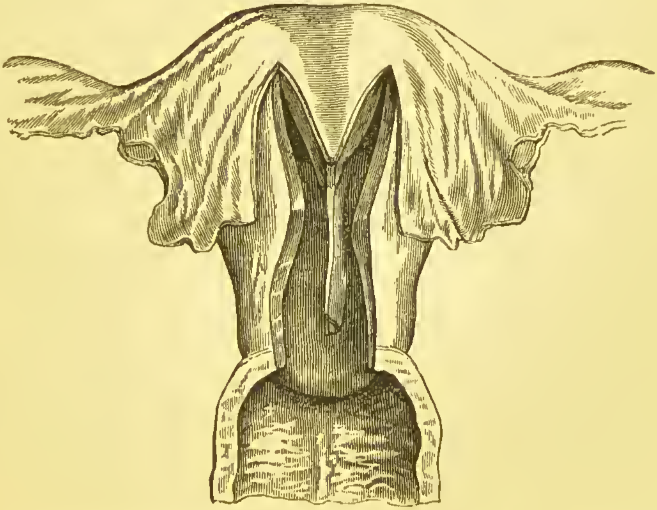

Fig. 118.—Extreme form of uterus bicornis, the lower part of cervix only being single.

development could not be due to failure in this respect. If ovulation occurs up to the time when, at about the fourth month, the decidua vera and reflexa come into contact, and the decidual cavity is obliterated, there is no *à priori* impossibility in a second ovum becoming implanted upon the developing mucous membrane.

In the case of a double uterus (see Fig. 117), or one of uterus bicornis, in which the fundus is completely divided into two parts (see Fig. 118), there would be no obstacle to the production of superfœtation if ovulation ever occurred during pregnancy. When pregnancy exists in one side of such a uterus, a decidua is generally developed on the other side also. Unless this change in the mucous membrane prevented the implantation of the ovum, superfœtation need not be limited to the first three months of pregnancy, but might occur much later. In some cases of apparent superfœtation the existence of a double uterus has actually been verified. It may have existed in others also without being detected, for if the septum is limited to the body of the uterus, and the os is single, it is not always possible to discover the condition during life.

Most of the cases, however, which have been adduced as evidence of superfœtation, are explicable in other ways. If twins are born together of apparently very unequal development, this may be due simply to one twin having failed to obtain an equal share of nutriment, as already described (see p. 262). If the less developed embryo is not alive, it is almost certain that it is simply a case of blighted ovum retained without decomposition. The cases which are chiefly relied upon for proving superfœtation are those in which two children, both of which survived, have been born with an interval of some weeks or months between them.* Even of these, however, most may be explained by supposing that the more developed fœtus of twins was born prematurely, and that the other was retained either in a single or double uterus until it became fully developed. The strongest evidence in favour of superfœtation is derived from one or two well-established cases in which viable children have been born at an interval of about *four months.*† These can apparently only be explained by the supposition either that the first child was premature within the limits of viability, and that the second was due to superfœtation within the first three or four months of pregnancy, or else that (the first child being born at full term) superfœtation had taken place at a later period of pregnancy, an occurrence which would be possible only with a double uterus.

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* For a case of this kind, in which the uterus was double, see a paper by Dr. Ross, Lancet, August, 1871.

† "A Critical Enquiry regarding Superfœtation, with Cases," by Dr. Bonnar, Edin. Med. Journ., Jan., 1865.

A case observed by Dr. Tyler Smith * also affords considerable evidence in favour of superfœtation. A woman miscarried at the end of the fifth month, and some hours afterwards a small clot was discharged, enclosing a perfectly fresh and healthy ovum of about one month. The patient had menstruated regularly during the time she had been pregnant, and was unwell three weeks before she aborted. There were no signs of a double uterus. This case is specially interesting from the coincidence of menstruation during pregnancy with supposed superfœtation, but it is open to the possible doubt that the ovum, though apparently fresh, might have been retained after death without decomposition.

The conclusion is that in many instances superfœtation has been assumed without sufficient ground, but that in very rare cases there is as strong evidence of its occurrence as the nature of the case permits. Whether in any of these there was a normal uterus is not absolutely certain.

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* "Manual of Obstetrics," p. 172.

CHAPTER XVII.

PHYSIOLOGY OF THE PUERPERAL STATE.

By the puerperal state is meant the condition of the woman during the time when she is recovering from the effects of labour, and the pelvic organs are returning, so far as they do return, to their former condition. This extends over a period of as much as six weeks in normal cases, and is apt to be extended longer when any disturbance occurs. Though the puerperal state must be regarded as, in the main, physiological, yet it borders very closely on the pathological, and morbid processes very readily arise in it. The tearing across of vessels, formation of thrombi in them, and rapid cell production from the surface of the uterine mucous membrane are different from anything else which occurs under normal conditions. In a large proportion of women, moreover, including all primiparæ, there are actual traumatic lesions to be recovered from, consisting of more or less bruising and laceration of the vaginal outlet and vulva, not unfrequently also of the cervix and adjoining cellular tissue.

The exertion of labour is normally followed by a sense of extreme relief and calm. If, however, labour has been severe, there may be signs of nervous exhaustion. There may be a slight rigor, due to actual chill from the cessation of muscular activity, coupled with the cooling of the skin by perspiration. This is soon relieved by warm clothing. Refreshing sleep generally soon follows, and does much to restore the patient.

Pulse and temperature.—After delivery the pulse falls to a rate below the normal, sometimes as low as 50 or even lower. Sometimes the rate is still further diminished on the second or third day, and a frequency even as low as 40 has been noted. Frequently it regains its usual rate about the third day, but it may remain low as long as a week; such retardation of pulse may be taken as a sign that all is going well. Like the temperature, the pulse of lying-in women is readily affected by slight causes, whether emotion or constitutional disturbances, but not to so great an extent. So long as the disturbance is slight, temperature is a more delicate indicator than pulse.

Temperature is often raised a degree or two during the latter part of labour, if at all severe or protracted, and remains elevated for a short time afterwards. Soon it sinks to the normal level, and generally somewhat below it. Throughout the puerperal state, and especially for the first ten or fourteen days, the temperature very easily becomes elevated from any slight cause, readily rising even as high as 101° or 102°. Such cause may be local inflammation due to laceration of perineum or cervix, mental emotion or shock, irritation of breasts accompanying the secretion of milk, or slight septic absorption at some exposed surface, which does not go on to produce more serious symptoms. Even constipation, or slight imprudence in diet, appears to be capable of causing a rise of temperature. All these causes act more readily on highly neurotic subjects. A rise of temperature about the third day accompanying the secretion of milk has even been considered by many authorities to be a normal occurrence. It does not appear, however, that any notable rise of temperature should be regarded as necessary, or absolutely normal; and the elevation about the third day is probably due, much more often than was formerly supposed, to a slight septic or traumatic disturbance. The so-called "milk-fever" is not therefore to be regarded as a physiological occurrence. In normal cases, if temperatures are taken only twice a day, it is exceptional to observe a rise of temperature of more than about one degree. Thus of women after normal labours attended in Guy's Hospital Lying-in Charity, on whom observations on temperature were made, a reading above 100° F. at any time was noted in only 12 per cent. even before the introduction of perchloride of mercury as an antiseptic, and no special tendency to elevation about the third day was observable.* On the other hand, in lying-in hospitals, even when free from any apparent unfavourable influence, a considerable rise of temperature was more common previous to the recent perfection of antisepsis, by which pyrexia after delivery has been, to a great extent, banished.†

Hence a rise of temperature of more than two degrees should always arouse some anxiety, and be an indication for very careful watching of the patient. But in the absence of corresponding elevation of pulse, or other unfavourable signs, it often proves transient, and does not necessarily mean danger. It is only to be attributed to the secretion of milk when it accompanies some local discomfort, or fulness in the breasts, and subsides as soon as the flow of milk becomes free and normal.

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* Guy's Hosp. Reports, Vol. XVII.

† "Observations on Puerperal Temperatures," by Mr. E. S. Tait, Obst. Trans., Vol. XXVI.

Secretions and excretions.—The skin is generally moist so long as the patient remains in bed, and sweating is readily excited. The bowels are sluggish. Secretion of urine is copious, the excretion of urea considerable, taking into account the light diet and rest in bed. A slight degree of glycosuria is common, and may be regarded as physiological.* It is noted especially when the milk is first secreted. It disappears afterwards if the consumption balances the secretion of milk, but appears again if the breasts become over-full, or the consumption of the milk is checked. It appears, therefore, to be due to resorption of milk-sugar from the secreted milk, or else to elimination of sugar, formed with a view to the lacteal secretion, but not utilised. The form of sugar present is said to be lactose, not glucose. This would seem to prove the origin of the sugar to be resorption from the breasts.

There is commonly some difficulty in micturition for the first few days, due partly to the mere effect of position, partly to the effect of pressure upon the neck of the bladder and the urethra. Necessity for the use of the catheter is, however, exceptional.

Involution of the uterus.—Rhythmical contractions of the uterus continue after the expulsion of the placenta, and are more or less perceptible for some days afterwards, becoming gradually less marked as the uterus diminishes in size. In the intervals of the active contractions, a certain amount of muscular tonicity normally persists. When the contractions cause a painful sensation to the woman, they are called "after-pains." The rapid diminution in the size of the uterus is closely associated with the lessened flow of blood through it. This lessened flow depends mainly upon two causes: first, the removal of the stimulus caused by the presence of the growing ovum; secondly, the compression of the vessels produced by the retraction and closure of the emptied uterus and the maintenance of a tonic contraction of its walls. The process of reduction in size goes on most actively for the first week after delivery. After this it continues with diminishing rapidity, and is not complete until from six to eight weeks have passed. Immediately after delivery the uterus weighs, on the average, about 33 ounces, and its cavity measures about 7 inches. At the end of a week it weighs about 16 ounces, and its cavity measures about 4¾ inches in length. At the end of a fortnight it weighs about 12 ounces, and the cavity measures about 4 inches.

Immediately after delivery, the height of the fundus above the pubes is, on an average, about 4½ inches, but varies much in different cases. A few hours after delivery, even up to 12 hours, the fundus generally appears to be higher than before. This is attributed to the filling of the bladder and rectum, which elevate the uterus out of the pelvis. A diminished intensity of the tonic contraction of the uterine wall may also contribute to the effect. By the end of 24 hours diminution begins to be apparent. At the end of a week the fundus is still felt about 3 inches above the pubes. At the end of two weeks the fundus is still as much as 1½ inches above the pubes (see p. 286), but soon after this it becomes difficult to feel it by external examination alone.

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* De Sinéty, "Recherches sur l'Urine pendant la Lactation," Gaz. Méd. de Paris, 1873.

The mechanism of the process of involution is that the enormously developed muscular fibres of the pregnant uterus (see p. 103) are absorbed. It has generally been stated that the fibres undergo fatty degeneration previous to the absorption. Modern observers, however, deny the fatty degeneration. The fibres have under the microscope a slightly granular appearance, which is probably due rather to albuminoid than to fatty degeneration. Thus the proper performance of involution depends upon a due action of the absorbent system, as well as upon the diminution of the blood supply. It is apt to be interfered with by any constitutional condition which impairs this, as well as by any cause which prevents the proper contraction of the circulation. The place of the large fibres is eventually taken by small muscular fibres, resembling the original fibres of the unimpregnated uterus. These are believed to be developed anew from the nuclei in the uterine wall.

The arteries which have been so greatly increased in size during pregnancy become diminished by the contraction of their calibre. Their walls, however, remain thicker than in the unimpregnated uterus, and this change is a permanent one. Thus, in a section of the parous uterus after involution, the arteries, which are apparently more numerous than in the nulliparous organ, project beyond the surrounding surface, present thick yellowish-white walls, more opaque than the tissues around, and their canals remain patent.

The obliteration of the large venous sinuses of the placental site takes place in the following manner: After delivery, thrombi are formed in them.* Then proliferation of the lining membrane takes place, so that it forms a glassy-looking transparent substance, thrown into folds, reminding one of the appearance presented by a corpus luteum. This folded layer, in some cases, completely closes the channel. In others the centre is occupied by the remains of the thrombus, which has become organised, apparently by the growth into connective tissue cells either of the leucocytes contained in it, or of wandering nuclei from the tissues. These changes are most fully developed at the end of four weeks. But even up to the end of twelve months the convoluted appearance may still be discernible. It may therefore be of great importance as medico-legal evidence of a previous pregnancy.*

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* According to some authorities thrombosis of the sinuses begins for a month or so before delivery, but it is probable that this is a morbid, not a normal process.

Changes in the mucous membrane.—The portion of the decidua vera superficial to the ampullary layer (see Fig. 34, p. 56) normally comes away as a layer blended with the chorion. The remainder, infiltrated with blood, remains attached for a time to the interior of the uterus. Gradually the superficial part of it, consisting mainly of the ampullary layer itself, with sometimes portions of the upper cellular layer still remaining attached, breaks up, having undergone fatty degeneration, and is discharged in shreds with the lochia. The muscular wall of the uterus is never entirely laid bare; for the deepest layer of mucous membrane remains attached, including the dilated extremities of the glands. The interglandular part of the mucous membrane is reconstituted by proliferation of the connective tissue cells. The cylindrical epithelium lining the new glands, and that which eventually covers the mucous surface, is probably derived from the epithelium which remained at the deepest portion of the old glands.

The placental site.—The portion of mucous membrane left over the placental site is thinner than elsewhere, so that the muscular wall is more nearly exposed. The regeneration of mucous membrane takes place more slowly over this surface, and the involution of the uterine substance is also slower at the placental site. Hence, about a week or ten days after delivery, the placental site forms a prominence with uneven surface, convex toward the uterine cavity. This, in some cases, it might be possible at first sight to mistake for a new growth in the uterine wall, or portion of placenta remaining attached.

The cervix uteri and vagina.—The internal os takes part in the contraction of the uterine body on the expulsion of the placenta. Contraction is indeed specially marked at this part, so that the internal os can be felt from the inside as a definite ring. It remains, however, for a time large enough to admit one or two fingers. The cervix does not take part in the contraction, and continues for a considerable time thin, soft, and flaccid, having a length of about three inches or more. Its edges are frequently irregular from laceration, and sometimes the laceration extends as deeply as the vaginal reflexion. When the laceration is deep it is most frequently either on the left side, or bilateral, the cleft on the left side being the deeper. The reason of this appears to be that the occiput is most commonly directed toward the left side, and escaping first from the ring of the cervix, is most likely to cause laceration of it. The internal os may remain patent enough to admit the finger for a week or more, but usually ceases to be so after ten days. The cervical canal remains patulous for a longer time, and its involution is not complete till the end of six or seven weeks. Involution of the vagina occupies about the same time as that of the uterus. After a first delivery its outlet remains permanently wider than before, as the clefts which have been torn in it do not entirely unite again, but heal up by granulation.

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* "Changes in the Uterus resulting from Gestation," by Dr. J. Williams, Obstet. Trans., Vol. XX.

The lochia.—A discharge takes place for the first two or three weeks after delivery, called the lochia, or lochial discharge. It arises from the internal surface of the body of the uterus, with the addition of the secretion of the cervix and vagina. At first the discharge is almost pure blood. With it may be passed large clots, especially if the uterus is not well contracted, so that blood is poured out more freely, and space and time allowed for it to coagulate within the uterus. For the first three days blood still predominates, but is mixed with serous exudation, leucocytes, epithelial cells, shreds of decidua, and fatty and granular cells derived from the degenerating decidua. Clots, generally small, may still be passed from time to time. After the third or fourth day, the proportion of blood diminishes, and that of serous fluid increases. The colour of the discharge, hitherto dark red (*lochia rubra* or *cruenta*), now becomes paler (*lochia serosa*). The proportion of blood corpuscles progressively diminishes, and that of the other constituents, especially the leucocytes, increases. About the ninth day the colour becomes yellowish-grey, or slightly greenish, from a small quantity of blood being still present (*lochia alba, green waters*). The constituents at this time are chiefly leucocytes, granular cells, fat, epithelial cells, and cholesterine crystals. From this time the discharge gradually diminishes until it merges into the character of the non-puerperal secretion.

The reaction of the lochia is alkaline. The discharge has a peculiar, disagreeable, smell, from the secretion of the glands. It very readily becomes decomposed upon the napkins, but, within the vagina, it has not normally the odour of decomposition. If such an odour is observed, it indicates the probability of some clots or placenta being retained, unless due to septic infection conveyed from without. Bacteria, however, are usually present, and it has been found that, after the first day or two, the lochial fluid has a septic influence, if injected into the tissues of animals, and that this becomes during the first week greater the greater the interval after delivery.* It is probable that normally, before this deleterious quality is developed, any breaches of surface in the genital canal become covered with granulations, and so protected from absorbing readily.

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* Prof. Kehrer in "Arch. für Gynäk." B. xi., H. 2.

The quantity of the lochial discharge varies much in different women, like that of the menstrual flow, and is apt to be more abundant with those who habitually menstruate profusely. Generally the quantity is greater if the woman does not suckle, the stimulus to uterine contraction being lost. After the red colour has ceased, it is apt to return if the woman gets about too early, or exerts herself too much. The total quantity for the first week, according to Gassner, is on the average 38 ounces for those who suckle, 66 ounces for those who do not.

After-pains.—The intermittent contractions of the uterus, which continue after delivery, serve to expel any clots which may be retained within the uterus, and assist in diminishing its blood supply. They occur normally in all cases, but are only termed after-pains when they cause a painful sensation, either in consequence of the vigour of the contractions or of undue sensitiveness of the uterus. Such after-pains are most marked for the first day after delivery, but they may persist, with diminishing severity, for four or five days. They are generally excited by the presence of some clots or shreds within the uterus, but their intensity varies also with the nervous sensibility of the patient, so that, in this respect, they are in some measure analogous to the pain of dysmenorrhœa. They are scarcely noticed when a good continuous uterine contraction is secured from the first, and no clots are formed within the uterus. Thus in primiparæ they are absent, as a rule, and are most marked in women who have had many children, or when the uterus has been over-distended, as by twin pregnancy. They are more marked when pains have been feeble during delivery than when they have been violent. After-pains are excited in a reflex manner, as uterine contraction always is, by suckling the infant.

After-pains are thus salutary, in a measure, in that they cause the expulsion of clots. But it is still better to avoid them by preventing the formation of clots. The best prophylactic is to make sure that the uterus is emptied of clots at the completion of the third stage of labour, and that a good contraction is maintained afterwards.

After-pains are distinguished by their intermittent character, and by the absence of tenderness or constitutional disturbance. The fundus uteri may also be felt to harden with the pain.

Secretion of milk.—The evolution of the breasts during pregnancy has been already described (see p. 113). The typical appearance of a section of the mammary gland, as generally shown in figures, in which each acinus is regularly lined with a mosaic of polyhedral granular cells, exists only when the function of lactation is in full exercise. Before evolution, and during its earlier stages, the acinus is filled irregularly with cells, whose character varies according to the stage of evolution. By the time of delivery the cells have become large, round, containing a nucleus and fat particles, often vacuolated, and regularly arranged round the wall of the acinus,* which contains also some mucoid fluid.

The small quantity of secretion for the first two days after delivery is called *colostrum*, and does not differ materially from the fluid which may be squeezed from the breasts before delivery. It is a clear, somewhat slimy, mucoid fluid, containing yellowish opaque dots and streaks. These dots and streaks are made up of the *colostrum corpuscles*, large nucleated cells, granular with fat particles. These are identical with the cells already described as lining the acini. The secreting cells at this time, therefore, are discharged entire. Some milk corpuscles also are already present. Besides having the colostrum corpuscles, colostrum differs from milk in containing, not casein, but albumen; a precipitate is therefore formed on boiling it. Colostrum has a laxative effect on the infant. If therefore the child is put early to the breast, there is no need to give it the castor oil which many nurses are fond of administering.

About the third day the breasts become full, congested, sensitive, and often somewhat knotty. The thin bluish milk now appears in abundance, and takes the place of the colostrum. For awhile some colostrum corpuscles may still be seen on microscopic examination, but the milk corpuscles, minute round fat globules, now become the predominant constituent. These are formed within the secreting cells, which dissolve and set them free. When lactation is fully established, the secreting cells are no longer discharged entire.

It has already been explained that the so-called "milk-fever," to which the synonyms of "ephemera" or "weid" have been given, is not to be regarded as a physiological occurrence, and that a rise of temperature about the third day is often due to some transient septic or traumatic disturbance. Febrile disturbance may, however, be produced about this time by irritation and tension, or a slight degree of inflammation, in the breasts, especially if suckling is difficult at first on account of an undeveloped or flattened condition of the nipples. When it occurs it is to be regarded as the constitutional disturbance set up by a local cause.

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* "Physiology and Pathology of the Breast," by Dr. C. Creighton.

Composition of the milk.—The casein is formed by the
gland epithelium from the albumen of the blood. The milk-sugar
or lactose, as well as the fat in the form of milk globules, is also
formed in the gland. The minute oil globules are believed to be
kept in emulsion by the dissolved casein forming a film around
them. The average proportion of the solid ingredients in human
milk is as follows:—Butter, 3·5 per cent.; casein, 3 per cent.;
3·5 milk-sugar, 4·6 per cent.; salts, 0·2 per cent.; a trace of the
3· albumen, present in the colostrum, still remains, about 0·4 per
4·6 cent. Hence a precipitate of slight flocculi is formed on boiling
·2 milk. The proportion of butter may, however, vary between 2·6
N ·4 and 7 per cent.; of casein, between 2 and 4 per cent.; of milk-sugar, between 3·5 and 6 per cent.

The quantity of milk, in women who are able to nurse well, increases up to about six or seven months, after which it diminishes. This is an indication that it is desirable, at this time, to begin to give the infant other food in addition. As time goes on, the relative proportion of casein becomes greater, that of butter and milk-sugar less. In feeble women the milk often diminishes or disappears after three or four weeks, either because the supply to the system derived from the involution of the uterus then fails, or because the woman is not strong enough to produce milk in addition to the expenditure of energy in being up and about.

Diagnosis of the puerperal state.—The woman has the general appearance of having passed through some illness, especially if delivery has been concealed. The abdomen is often slightly full, but lax, and the skin wrinkled. Skin-cracks (lineæ gravidarum), red or white, are generally present. Pigmentation is usually visible in various parts, and especially in the form of a central dark line from ensiform cartilage to pubes. This becomes much more marked during the few days after delivery than it is during pregnancy. The breasts are full, generally contain colostrum or milk, and show the other changes associated with pregnancy and lactation. The fundus uteri can usually be felt above the pubes up to about the fourteenth day. For a much longer time its large size can be detected on bimanual examination. The vagina is lax and gaping, and often shows lacerations, especially at the border of the perineum; the hymen, if any of it remains, is torn completely to its base. The cervix is soft and patulous; its edges often show lacerations or bruising. The internal os is smaller, but may be large enough to admit the finger into the uterus. The lochial discharge will generally be present, its character depending upon the interval since delivery. The characteristic softness of the tissues in the puerperal state, especially of the cervix, vagina, and perineum, is absent in pathological conditions, or after operations within the pelvis.

Diagnosis by these signs will rarely be difficult within ten or fourteen days after delivery. In case of doubt, toward the end, or after the end, of that period, observation of the progressive diminution in size of the uterus may be of value. An approximate estimate may be formed of the date of delivery by the height of the fundus uteri above the pubes, by the character of the lochia, of the secretion in the breasts, whether colostrum or milk, by the condition of any lacerations, whether granulating or cicatrised, and by the degree of relaxation of cervix and vagina.

Diagnosis of Parity.—To diagnose, after a considerable interval, whether a living woman has borne children, is often difficult. The most reliable signs are to be found in the conditions of the vaginal outlet and hymen. From the effect of coitus, the hymen only becomes notched at its edges, while the whole circuit of its vaginal attachment may still be traced as intact. After parturition, in some cases, it is broken up into sections, separated from each other by smooth patches of mucous membrane, the result of lacerations reaching completely down to the vaginal wall. In others, the hymen is only represented by projecting tags of mucous membrane here and there, the so-called carunculæ myrtiformes; while in others again, in which the broken-up fragments have sloughed away after labour, no trace of it remains. This characteristic condition of the hymen in the parous woman is produced, not merely by its more extensive laceration, but by the sloughing of some intermediate portions from the effect of bruising and pressure. The only thing which could possibly simulate the effect of parity in a nulliparous woman is the delivery of a large tumour, such as a fibroid, through the vagina. Deficiency of the perineum, indicating a former rupture, is a valuable sign when it exists.

The presence of white lines on the abdomen (lineæ gravidarum), indicating old skin cracks, justify only a suspicion of a previous pregnancy, for these may result from distension by a tumour, or even merely by fat.

Changes in the cervix.—Changes in the cervix are significant when observed, but their absence proves little or nothing, since, when no laceration occurs, the cervix may return almost completely to its former condition. As a rule, in the nulliparous uterus, the os is oval, smooth, and comparatively small. In the parous uterus it is a wider lateral cleft, dividing the cervix more or less into an anterior and posterior lip. If there is a deep lateral cleft on one or both sides, especially if the anterior and posterior lips are rolled apart, and so altered by hyperplasia that they offer some resistance when an attempt is made to draw them together, the evidence is still stronger. These conditions of the cervix may be recognised by digital touch alone, and the conclusion may also be confirmed by examination through the speculum. A Sim's speculum should be used, and given to an assistant to hold. To demonstrate any eversion of the cervix, the physician should

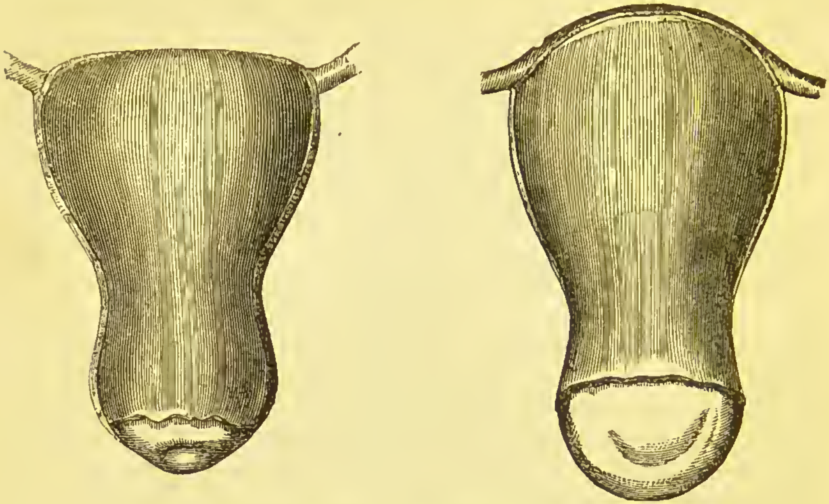

Fig. 119.—External views of the nulliparous and parous uterus.

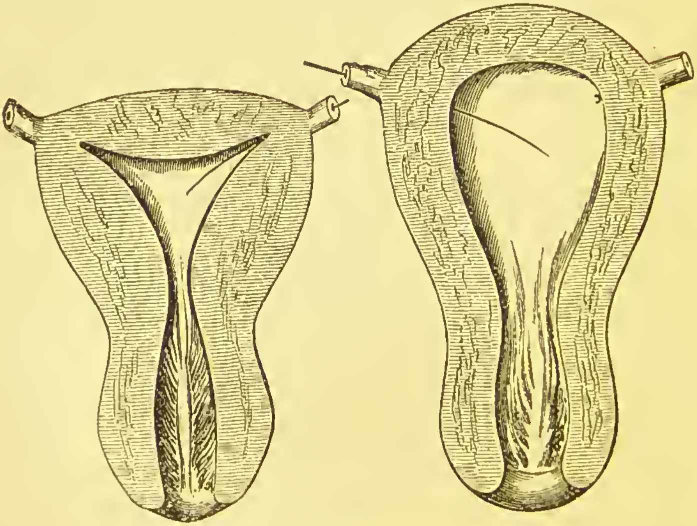

Fig. 120.—Sections of the nulliparous and parous uterus.

take a Sim's sharp tenaculum hook in each hand, fix one in each lip of the cervix, crossing the shanks, and draw the two lips together, thus rolling inward any intra-cervical mucous membrane which has become everted.

Differences between nulliparous and parous uterus.—It may be of critical medico-legal importance, in identifying a dead body, to determine whether the woman has borne children or not. To determine this point, the examination of the uterus is most important, and such examination may be possible when external parts are defaced by decomposition. As a rule the parous uterus is larger than the nulliparous, and its walls thicker. No decisive importance must, however, be attached to this sign, since a nulliparous uterus may be hypertrophied, and a parous uterus may undergo super-involution until its walls become extremely thin. The most ready distinction is to be found in the shape of the organ. In the nulliparous uterus, the top of the fundus externally, as seen from the front or back, is almost level, scarcely rising above the line of the broad ligaments; in the parous uterus, it is markedly convex, rising considerably above that line (Fig. 119, p. 278). Again, if a longitudinal section is made from side to side, passing through the cavity, in the nulliparous uterus, the walls of the body are seen to be convex inward, leaving but a small cavity; in the parous uterus they are concave inward, leaving a much larger cavity (Fig. 120, p. 278).

The convoluted margins of the old sinuses of the placental site, if observed, afford absolute evidence. These are distinguishable for some months, and, according to Dr. J. Williams (see p. 271), so long as twelve months. Pigmentation at the placental site may also be observed. The thickened appearance of the arteries in the uterine wall is a permanent condition (see p. 271).

Most, if not all, of these signs, with the exception of the convoluted walls of the sinuses, might possibly be simulated after the growth of a large fibroid tumour, and its delivery through the genital passages.

THE NEW-BORN INFANT.

The change of circulation which takes place immediately after birth has already been described (see p. 85). After birth, the left ventricle being now distended by blood at a higher pressure, and having harder work to do, quickly becomes larger and thicker, in proportion to the right, than it was during fœtal life.

The rectum soon becomes active, and expels the meconium. In two or three days the motions assume the ordinary fæcal appearance, becoming yellow instead of green. The bowels normally act at intervals of a few hours, the motions being soft, of about the consistency of mustard. Urine is copious, on account of the liquid nature of the food, and of low specific gravity.

Up to the third or fourth day, when it obtains for the first time an ample supply of milk, the child loses weight. It regains its original weight at the end of about a week, and from that time increases progressively. The temporary loss may be as much as seven or eight ounces.

The remnant of the umbilical cord dries up from the extremity toward the umbilicus, and a line of demarcation is formed close to the edge of the skin, at which it is separated generally on the fourth or fifth day, sometimes later. A granulating surface is left, which cicatrises in a few days. The caput succedaneum generally disappears after a day or two, and in a few days, or within two weeks at the utmost, the head returns to the original shape, from which it had been altered by the moulding produced in delivery.

For a week or more the skin is red and superficially congested; and there is desquamation of the cuticle, generally in fine flakes. Within the same time, the mammary glands, both of boys and girls, are apt to become red and swollen, and may produce a mucoid secretion. This condition is to be regarded as forming a part of the cutaneous hyperæmia. The slight inflammation passes off in a few days, unless the glands are irritated by manipulation.

When the hyperæmic redness of the skin is beginning to pass off, toward the end of the first week, sometimes as early as the second or third day, the skin often becomes coloured yellow by jaundice, or apparent jaundice, and the conjunctivæ partake of the same tint. Generally the appearance of the fæces is unaltered, the urine is not pigmented, and the infant does not appear to suffer much in health. The yellow colour usually subsides and disappears after about a week. There has been some doubt whether this condition is true jaundice or not. There is no doubt that jaundice occurs from pyæmic affection of the liver, due to the infection of puerperal septicæmia. It is probable also that true jaundice may be set up in some way not fully explained, in connection with the sudden change at birth in the circulation through the liver.* But the slighter forms of apparent jaundice, in which fæces and urine are unaffected, are ascribed with probability to changes in the blood. It is supposed that a surplus of red corpuscles is broken up in the circulation, and that colouring matter derived from hæmatoidin transudes into the tissues. In support of this view, it is reported by some observers that jaundice is commoner when the infant is allowed to receive more blood, by the deferring of the ligature of the funis (see p. 217). The yellow tint, when manifested in this slighter form, generally passes off without treatment within about a week.

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* The diminution of pressure in the capillaries of the liver would at any rate diminish the resistance to the passage of secreted bile into the circulation.

CHAPTER XVIII.

MANAGEMENT OF THE PUERPERAL STATE.

In the management of the puerperal state, the most essential points are to secure for the lying-in woman rest, both bodily and mental, for a sufficient period, and to prevent the access of any septic influence by the most careful regard for cleanliness and hygiene. The susceptible condition of the nervous system which exists during pregnancy, continues, and is even more marked, during the puerperal state. It is important, therefore, to see that the patient is not excited by the visits of friends, or by too many persons in the room ; and to protect her, as far as possible, from any source of painful emotion.

Cleanliness.—All soiled linen and sheets should be removed after delivery, and not kept in the room. The diapers used to absorb the lochial discharge should be changed frequently, before they become offensive to smell. Antiseptic wood-wool diapers, or the "ladies' sanitary towels" stuffed with absorbent cotton, are preferable to the ordinary diapers, since the latter may not have been perfectly purified in the wash. Linen and sheets must be changed whenever they become soiled. A fire in the room is useful, for the sake of ventilation, when the weather is not warm enough to allow a window to be kept open. Care should be taken that the lying-in room is not exposed to foul air from a water-closet, or to access of sewer gas, or other septic exhalations. The room should be aired occasionally, if the window is not open, care being taken to protect the patient from draught. For this purpose the window may be opened for a minute or two, once or twice a day, even in winter, the patient's head being covered meanwhile with a shawl. It is better not to darken the room, except when the patient finds the light trying, for light is healthful both to mother and infant. The external genitals should be washed several times a day with a weak solution (from 1 in 50 to 1 in 80) of carbolic acid. For this purpose, since sponges readily retain septic material, it is better to use wads of absorbent cotton, which are afterwards destroyed.

Authorities are not agreed whether it is desirable to irrigate the vagina as a routine practice in all cases, although all allow that this should be done if the lochia become offensive. The author's own experience is, that a course perfectly free from febrile disturbance throughout the puerperal state is more common when regular irrigation is employed, and he believes that this precaution tends to prevent evanescent elevations of temperature, as well as more serious septic disturbances. If used at all, the irrigation should be used regularly, at least twice a day. Otherwise the vaginal tube may rub off some granulations, and leave a spot more prone to the absorption of the septic material allowed afterwards to form. Again, it is better to use no routine douches at all than an inefficient antiseptic, or one which is too much diluted; for pathogenic germs may then be introduced in the water of the douche. Moreover, it has been found by experiment that the normal mucus in the vagina, probably on account of harmless microbes present in it, has a destructive effect upon septic microbes. Harm may therefore be done by washing away the normal secretion by anything but an efficient antiseptic.

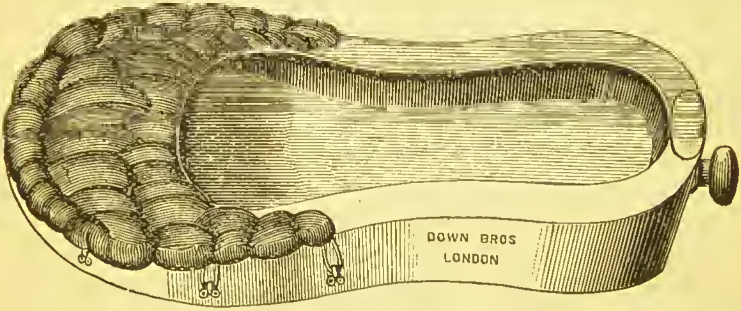

Fig. 121.—Ladies' bed-bath.

Hitherto the only reliable test of the efficacy of antiseptic precautions has been the results obtained in lying-in hospitals; and these have been secured by the use of mercurial douches during the puerperal period. Such douches have not been abandoned, although the most recent tendency is to restrict their use.

For use in private practice, a solution of mercuric iodide 1 in 4000, used twice a day, is an efficient antiseptic, and is free from the risk of producing poisonous effects, provided that it is used by a skilled nurse, and that care is taken that no excess of the solution is allowed to remain in the vagina. If the mercurial solution is found at all irritating to the vagina, it may be replaced, after about five days, by chinosol 1 in 2000, or tincture of iodine ʒii. ad Oj. If efficient and intelligent nursing cannot be obtained, it is better to use no irrigation, unless the discharge becomes offensive, or the temperature rises.

The syringing may be carried out either by Higginson's syringe, or by an irrigator, a round bed-pan, or, better still, a "ladies' bed-bath"

(Fig. 121) being placed under the patient's hips. In the latter case, the cushion of the bed-bath should be a new one. The irrigator is preferable to the syringe, for it is less likely to introduce air, if a little fluid is allowed to flow from the tube before its introduction into the vagina. In general the nurse may use the irrigator or syringe ; but, if there is much soreness at the vulva, the patient may be able herself to introduce the tube with less discomfort. The vaginal tube, at least, should always be a new one for each patient. In lying-in institutions, or where there is any special fear of infection being spread, it is a good plan for the patients to adjust the tube of an irrigator for themselves, and to have vaginal tubes made of glass, sterilised by boiling.

Diet and general management.—Immediately after labour, it is a good plan to give some liquid nourishment, such as beef-tea, or an egg beaten up in milk. After the baby has been washed and dressed, and soiled linen removed, the patient should be allowed to sleep. If labour has been unusually severe, and the patient is restless, an opiate may be given, but it is preferable not to give one as a general rule. If after-pains are unusually troublesome, a mild anodyne,* rather than opium or morphia, is generally sufficient to meet the case. It was formerly the custom to keep lying-in patients on low diet, with the idea that such a regimen was antiphlogistic. It is now agreed that the better they are nourished, the more likely they are to resist disease. Frequently women do not care for meat, or for much solid food, for the first two or three days, and, in that case, there is no advantage in pressing the appetite. They should then have nourishing food in a digestible form, a fair allowance of milk in some shape, as well as soup or beef-tea, tea or coffee with toast or bread and butter, eggs, or milk gruel, according to taste. There is, however, no harm in giving fish, chicken, or digestible meat even before the third day, if the patient likes it, and in the absence of any rise of temperature or constitutional disturbance of any kind. After this time, in the absence of febrile disturbance, she may take ordinary simple diet in reasonable quantity, allowance being made for the fact of her being quiet in bed, and on the other hand for the material required for lactation. In the absence of lactation, less ample diet is required.

The physician should visit the patient within twelve hours after delivery, and daily for the first week. He should note pulse and temperature at each visit, unless there is a nurse who is able to record these night and morning. The first signal of any disturbance will often be given by a rise of temperature. At the first visit he should enquire whether urine has been passed, and, if the quantity passed is very little, he should make sure, by abdominal palpation, whether there is any distention of bladder. In case of retention, the catheter must be used at least twice a day. To prevent the setting up cystitis by carrying septic matter into the bladder, the lochia should be washed away from the vulva just before the introduction of the catheter by an antiseptic solution, such as mercuric iodide 1 in 4000, and the catheter itself washed in a solution of perchloride or iodide of mercury 1 in 1000, and anointed with an antiseptic lubricant, such as lano-creolin or perchloride of mercury 1 in 1000 glycerine. A new male gum elastic catheter of full size (No. 10 to No. 12) may conveniently be used, care being taken to push it only just far enough into the bladder to allow the urine to flow. For the first twelve hours at any rate, the urine must be passed in a horizontal position over a bed-pan, and this position is often a chief cause of the difficulty. After that time, if there is no excessive sanguineous discharge, the patient may, if necessary, be allowed to kneel up to pass her urine, or to sit up on the bed-bath, or turn over on to her face. For it is always desirable to avoid the use of a catheter if possible. She should be encouraged to vary her position in bed from time to time. If she lies constantly on the back, the lochial discharge is dammed up in the vagina by the perineum ; if she is always on one side, it may be retained in the uterus, the fundus bagging over to the dependent side. The kneeling up to pass urine, after the time has passed when it would cause risk of hæmorrhage, has the advantage that it assists the escape of the discharge. With the same object, after the first day or two, if the patient is doing well, she may be supported in a sitting position to take her meals. She should also be in the sitting posture, or have the shoulders supported by pillows, to give the infant the breast. These expedients are more called for, when the plan of vaginal irrigation is not employed. So long as the patient is doing well, it is not desirable to make vaginal examinations. If there is occasion for doing so, the hand should be washed first in perchloride of mercury 1 in 1000.

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* The following is a useful formula :—Potass. Bromid. gr. x. ; Tinct. Hyoscyami, ʒj. ; Sp. Camphoræ, ʒss. ; Mucilag. Acaciæ. ʒj. ; Aq. ad ℥j.: to be taken occasionally.

To obtain early warning of any septic or inflammatory mischief, it is desirable not only to keep a record of temperature taken at least twice a day, but to record the progress of involution, as indicated by the height of the fundus above the symphysis pubis. Bladder, and, if possible, rectum should be empty when the observation is taken. A convenient mode* is to record the height of the fundus on the temperature chart, taking the line representing each degree of temperature above 100° as representing also each inch above the pubes. Examples of this are shown in Figures 122, 123. Figure 122 shows the curve obtained from an average of thirty-four

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* "Notes on the Variation in the Height of the Fundus Uteri during the Puerperium." Stevens and Griffith. Obstet. Trans., 1895.

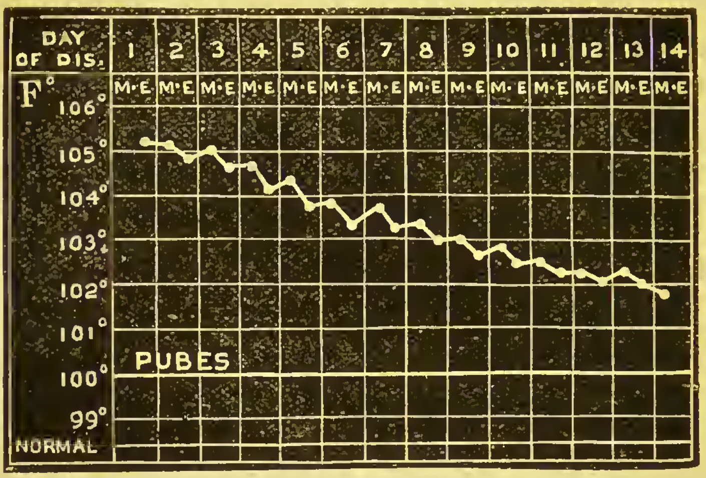

Fig. 122.—Chart showing involution of uterus. Average of thirty-four cases. (After Stevens and Griffiths.)

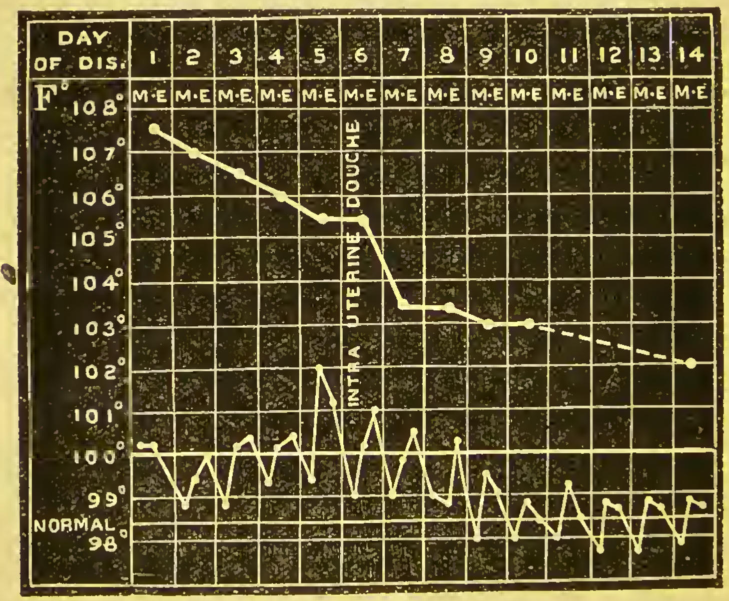

Fig. 123.—Chart showing involution of uterus. Sapræmia. Effect of one douche, and clearing out uterus. (After Stevens and Griffiths.)

cases; Figure 123 illustrates the effect of sapræmia in checking involution, and the result of one douche and clearing out uterus.

If possible, the patient should keep her bed for ten days, or for a longer time, if the discharge is still sanguineous, and she should return to it, if getting up brings on again a red discharge. On first leaving it, she should spend much of her time reclining on a sofa, and should not return completely to her ordinary mode of life, or undertake severe exertion, till the end of six weeks, at which time involution ought to be fairly complete. In the case of a primipara, when there has been much laceration, or bruising of soft parts, it is often desirable for the recumbent position to be maintained, for the most part, for three or even four weeks.

Action of the bowels.—It is usual to secure an action of the bowels on the third day, and it is not desirable to leave them confined longer than this. If the patient does not dislike it, and the nurse is skilful, a copious enema of soap and water avoids the necessity of an aperient. Otherwise a mild laxative may be given. The traditional castor-oil is often disliked. If not, it may be given in a dose of two drachms. Or its place may be taken by the compound liquorice powder, or tamar indien, or the following pill:—Ext. Aloes Socot., gr. $\frac{3}{4}$; Ext. Nucis Vomicæ, gr. ss.; Ext. Hyoscyami, gr. iij.; Pulv. Glycyrrhiz. *q. s.*

Lactation.—Not only does the infant thrive better when suckled than when fed artificially, but it is most important for the mother herself to suckle at least until the completion of involution, that she may not lose the stimulus to the contraction and involution of the uterus associated with the performance of that function. Even if the milk is deficient in quantity or poor in quality, she should at least partially nurse her infant for the first four or six weeks, if no longer. The only causes which should prevent this are entire absence of milk, or nipples which are useless for suckling either from flattening, want of development, or cracks which render suckling too painful. Lactation should not be continued after the puerperal period, either if the milk is poor in quality, so that the child does not thrive upon it, or if the mother's health is so delicate that injury to her from it is to be feared, especially if she has a tendency to phthisis, or belongs to a strongly phthisical family.

The child should be put to the breast for the first time within twelve hours after delivery, when the mother has had some sleep. For the first two days suckling should be repeated only two or three times a day. As soon as the milk is freely secreted, about the third day, the infant should be accustomed to take the breast at regular intervals of about two hours, a little later at three hours' interval, and afterwards four hours. During the night it may be allowed to sleep as long as it will, so that, if possible, the mother may not be disturbed more than once. No other food is generally necessary before the secretion of milk, but if the infant appears hungry, a few teaspoonfuls of milk and water, one of the former to two of the latter, may be given ; or, if sterilised, cow's milk may be given undiluted.

The child should lie in a bassinette, and not in the bed with its mother. It should never be allowed to go to sleep with the nipple in its mouth. After suckling, the nipples should be washed and carefully dried. This does much to prevent their becoming cracked. The child's mouth should also be washed out with a piece of linen rag dipped in water. By this means the production of thrush, by the growth of a fungus in the mouth, is prevented. It is a good plan to wash the nipples also before the suckling as well as after. Both breasts should be used at each time of nursing, that the tension may be equally relieved, if both are tense ; otherwise they may be used alternately. Primiparæ may require instruction in the mode of supporting the infant on the arm in a nearly horizontal position, and adjusting the nipple, so that the nostrils are not obstructed by pressing against the breast, but are free for breathing. It may be necessary for the mother to press down the areola by one finger placed above, the other below it, especially if the breast is tense or the nipple flattened.

The breast may become knotty and painful, when the milk is first secreted, from the secretion not escaping freely through the ducts. Gentle friction in the direction of the nipple is then useful, and, if the infant is not able to suck strongly, it may be desirable to draw a little milk with a breast glass, fitted with elastic tube and mouth-piece. If, however, suckling is not intended, and the milk is to be suppressed, all friction or drawing of the breasts should be avoided. The breasts should be supported, if swollen and tender, and gentle pressure made upon them. This may be done by covering each breast with a thin layer of cotton wool, and compressing it with two large handkerchiefs, one tied above the opposite shoulder, the other below the opposite armpit, or both breasts may be supported and gently compressed by a carefully adjusted bandage, the nipples being left free. At the same time the woman should drink little, and the bowels should be kept acting freely by a saline laxative, such as sulphate of magnesia. If necessary, belladonna may be used for its local influence in checking the secretion of milk, or may be given internally. The best method is to smear the breasts with glycerine of belladonna.* Iodide of potassium, which has a specific action in checking the gland-activity, may also be given in twenty-grain doses, three or four times repeated.

If the mother's milk is insufficient in quantity, she should suckle at longer intervals, and the breast should be supplemented by cows' milk suitably diluted, or sterilized, and given by the bottle. This plan is much better for the infant than an entirely artificial diet, although with the lower classes, it is often necessary to combat a prejudice against "mixing the milks." If, on the contrary, the milk is excessive, the mother should drink less liquid, and the bowels should be kept acting freely. It is rarely necessary to draw off the excess with a breast-glass, as the milk usually runs away spontaneously.

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* Ext. Belladonnæ, gr. lx.; Glycerini, ℥j.

The only mode of maintaining or increasing the secretion of milk is to give a diet with plenty of liquid, and a reasonable abundance of nitrogenous food, especially meat, fish, and vegetable food containing abundance of nitrogen, such as lentils, beans, or peas. A moderate quantity of stout or beer is advantageous if it does not disagree. The so-called galactagogues (such as castor-oil leaves locally applied) are not to be relied upon. Pilocarpine in small doses is reputed to be the most efficient.

Management of the new-born infant.—As soon after delivery as the nurse's attention is no longer required for the mother, she washes and dresses the child, which has meanwhile been covered up in a piece of flannel. She places it in a warm bath, and washes it all over with soap and water. First of all the eyes, and their neighbourhood, which have already been wiped clean from mucus, should be carefully cleansed by means of a piece of soft linen rag dipped in clean water. If the vernix caseosa be unusually adherent, it may be softened by smearing cold cream over it, but too much friction in removing it should be avoided. The mode of treating the funis traditional with nurses is to wrap it in a piece of linen in which a hole has been burnt, through which to pass the funis, and to change the piece of linen daily. It is preferable to wrap it in a piece of absorbent gauze, several layers together, or in absorbent cotton. The funis is then turned upward on the abdomen, and kept in place by a binder, which should not be too tight. After the funis has dropped off, a small flat pad of dry linen should be placed over the umbilicus until it has completely cicatrised.

The clothing of the infant should be warm, but not tight enough to compress thorax or abdomen, or interfere with the movement of the limbs. A diaper folded in a triangular shape is used. The anterior corner is brought up between the thighs over the abdomen, and kept in place by the lateral corners tied across it; no pins should be used about the baby. To prevent excoriation of the skin, it is of great importance to change the diapers as soon as they are wetted or soiled, and to cleanse and dry the buttocks. The child will generally give notice by crying when it has passed any evacuations. The child should be washed in a warm bath every day, and, after the first few weeks, morning and evening. The flexures should be thoroughly dried after washing, and dusted with pure starch powder. For the comfort of the mother it is desirable to accustom the infant, from the first, to go to sleep, laid quietly in its cradle, without nursing or rocking to sleep.

Selection of a wet-nurse.—When a mother is unable or unwilling to nurse, nourishment by a wet-nurse is undoubtedly more favourable for the child than bottle-feeding. With a patient of the upper classes, therefore, this alternative should be recommended.

The wet-nurse should have the appearance of good health, and be free from any sign or suspicion of syphilis, scrofula, or tuberculosis. She should also have sound, well-developed nipples, well-developed breasts, not too fat, and the milk should flow from them easily. The best age is between 20 and 35. It is preferable that the age of her infant should not be too far removed from that of the one to be nursed, but it should be older rather than younger. The best test of the quality of her milk is the condition of her own infant. This should also be inspected, especially about the buttocks, to make sure that there is no eruption or other sign suggesting any possibility of syphilitic taint. If the milk is specially examined, it should have a specific gravity of about 1030, give a per-centage of cream as much as 3 per cent. by lactometer, and under the microscope show abundant milk globules, no colostrum corpuscles. If the infant, after fair trial, does not thrive with one wet-nurse, it may be necessary to change her for another.

The diet of the wet-nurse and amount of exercise taken should be, as far as possible, what she has been accustomed to. If she is put upon an unnecessarily rich diet, and leads a more inactive life than before, the milk is apt to fail. Two meals of meat in the day, and about a pint of stout or beer, if she is accustomed to take alcohol, may be given.

Artificial feeding.—A large part of the mortality of hand-fed children in the lower classes is due to the fact that farinaceous food is frequently given within the first few months, at a time when, from the imperfect development of the salivary glands, the infant has little or no power of digesting starch. In general, only milk should be given for the first six months. Goats' milk and asses' milk both have the advantage over cows' milk in a closer resemblance to human milk. In general, however, cows' milk will be the only substitute available. The object, of course, is to make the substitute resemble human milk as closely as possible. The following table gives the average per-centage of constituents in each :—

	Human.	Cow.
Casein	3·0	4·6
Butter	3·5	4·0
Milk-sugar	4·6	3·8
Salts	0·2	0·6

The per-centage of casein and butter together is therefore 6·5 in human milk, 8·6 in cows' milk. It follows, therefore, that cows' milk may be reduced to about the same strength as human by adding water equal to one-third of the milk and a little sugar. But it will still be relatively rather too rich in casein, and too poor in cream. If water equal to *one-half* the milk be added, the proportion of casein will be about right, but the poorness in cream will be more marked. The chief difficulty, however, is in the digestion of the casein, and arises from the fact that the casein of cows' milk coagulates in larger, firmer curds, which are more difficult of digestion than the flocculi of human milk. Practically, therefore, it has generally been thought that for infants under two months a greater dilution than this is required, and equal parts of milk and water may be given, assuming that the milk has not been previously watered. In the absence of perfect sterilization of the milk, this rule still holds. The digestion of the casein is the chief point to be attended to. If undigested curds are vomited or seen in the fæces, the milk must be more diluted. For the first two or three weeks it may be necessary to give two parts of water with one of milk. It is a common mistake, however, with nurses to dilute the milk too much and too long. After two or three months the proportion of water may generally be reduced to half the milk ; after four to one-third, and from the fifth or sixth onward the milk may be given undiluted.

The water for dilution should be boiled. It is still better to use very thin barley water or decoction of arrowroot (ʒj. ad Oj.) ; this prevents the curds formed from being so large. This plan may, therefore, be adopted, if undigested curds are seen. Decoction of isinglass or gum may be used for the same purpose. It is preferable to sterilize the milk itself by heating it to the boiling point, or, better, by heating it in a proper milk sterilizer. This is the more desirable in towns where the milk cannot be got perfectly fresh.

According to the researches of Budin, it is best if the milk is efficiently sterilized to give it undiluted. It is found that, with sterilized milk, hard curds are not formed in the stomach, and experiments show that the infants gain weight more rapidly on undiluted than on diluted milk. A convenient form of milk sterilizer is drawn in Fig. 124. The boiling pan contains seven bottles, each containing a measure of food, and fitted with a valvular cap, which allows steam to escape, but prevents the entrance of air. The water is to be kept at the boiling point for forty minutes. A supply sufficient for twenty-four hours is thus prepared. When the food is required, a bottle is heated in the food warmer, till the thermometer marks 100°. The rubber cap is then taken off and replaced by a soft rubber nipple, and the bottle is at once given to the child. Milk sterilized in this way is found not to have suffered the diminution of digestibility which is noticed in boiled milk.

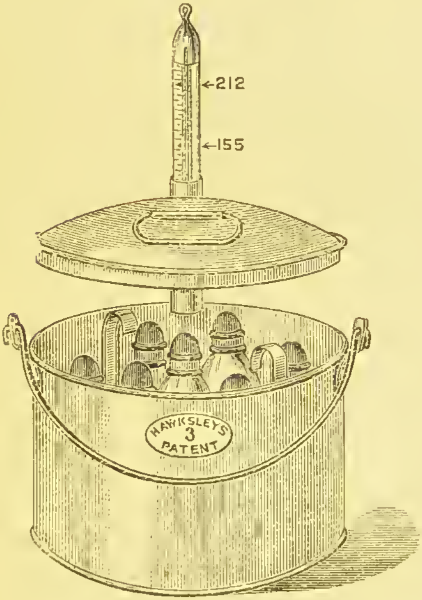

Fig. 124.—Hawksley's Milk Sterilizer.

The proper proportion of sugar to add is about 40 grains to four ounces of diluted milk. Milk sugar is of course the best, but, in the absence of it, ordinary white sugar may be added. Practically a small lump may be dissolved in each bottle of milk. The milk should be given warm, at a temperature of about 98° F. A young infant will not require more than from one to two ounces at a time.

It is often recommended that the milk should be from one cow. On the other hand, it is stated that the cow is liable to periods of heat even during lactation, and that then the milk is apt to disagree, whereas the effect is not noticed when the milk of a dairy is all mixed. In towns it obviously requires much faith to believe that milk from one cow is really obtained.

Condensed milk, diluted with water, has the advantage that the casein does not clot in such large curds as that of fresh milk. It sometimes agrees better therefore for a time when the infant does not digest the casein. It has a great disadvantage, however, of containing much too large a proportion of sugar. Its prolonged use seems unadvisable on this account, and, though fattening, appears to tend toward the production of rickets. Unsweetened condensed milk, which may now be obtained, is preferable, but will only keep about a day after the opening of the tin. With this a little sugar should be added at the time of use. It is still commoner with condensed than with fresh milk to make the mixture too weak. Four parts of water to one of milk make it equal in strength to fresh milk, not reckoning the added sugar. For the infant's use, therefore, not more than about nine or ten parts of water should generally be added, except for the first three or four weeks, when it may be necessary to add as much as fourteen or fifteen parts.

"Humanised milk" is now made by some of the dairy companies from cows' milk, by the addition of cream, freshly prepared whey, and milk sugar. This may be used with advantage, where it can be obtained, and can be sterilized in the same way as ordinary milk, in the milk sterilizer. If pure cows' milk can be obtained, a close approximation to human milk will be given by the following plan. Add to the milk half its bulk of water, and to each four ounces of the mixture, add forty-five grains of milk sugar, and two teaspoonfuls of cream. The whole is then to be heated in the sterilizer. The best cream is that obtained in the centrifugal separator, not by skimming, so that it may be supplied fresher.

The only farinaceous food allowable for young infants is Liebig's food, in which the starch is, to a considerable extent, already converted into glucose by the action of malt. If the infant will not thrive on milk, and a wet-nurse is not available, Liebig's food may be tried. Even this, however, does not answer so well before the third month as it does after that time, when the salivary glands are beginning to be active. Infant foods are prepared on Liebig's principle by Allen & Hanbury, Löflund, and others. Nestlé's infant food is a dry powder, in which part of the starch is also converted into glucose. It may be used after the third month.

In bottle-feeding the most scrupulous cleanliness is of essential importance. The food, unless sterilized as described above, should be prepared fresh each time of feeding; bottle and nipple should be most carefully cleansed and kept in water when not in use; and that form of feeding-bottle should be chosen in which the tube is dispensed with entirely, and the nipple fitted immediately to the neck of the bottle. If the milk cannot be obtained frequently fresh, to each bottle of milk may be added a grain or two of bicarbonate of soda, to correct any acid reaction; or if the infant has any tendency to diarrhœa, a little lime-water. Regularity of meals must be observed as with breast-feeding. The infant should always be nursed while it is feeding. The nurse must never be allowed to let the bottle remain in the cradle with the infant to soothe it to sleep.

When the child is seven months old, one of the farinaceous foods which contain all the ingredients of wheat, not merely starch, should be given in addition to the milk. From this time it is well to give also some gravy, or beef-tea, with a little bread.

CHAPTER XIX.

ABNORMAL PREGNANCY.

Ectopic or Extra-uterine Fœtation.

Under the head of abnormal pregnancy may be included all cases of what is commonly spoken of as extra-uterine fœtation, but may receive the more widely inclusive term of "ectopic" fœtation. By this is meant the arrest of the ovum at some point before it has reached the cavity of the uterus. Closely allied with this is the development of the ovum in one horn of a double uterus, when that horn is so rudimentary that pregnancy cannot go on in a normal course.

Varieties.—The ovum may either escape altogether into the peritoneal cavity, and become implanted there, or it may become arrested anywhere in its course between the Graafian follicle and the uterine cavity, and may or may not afterwards escape by rupture from its original situation. Hence we have the following varieties of ectopic fœtation:—1. Ovarian; 2. Primary abdominal; 3. Tubo-ovarian, or tubo-abdominal, when the ovum is contained in a sac formed between the pavilion of the tube and the ovary, or a portion of the peritoneum; 4. Tubal; 5. Tubo-uterine or interstitial, when the ovum is arrested in that part of the tube which passes through the uterine wall; 6. Secondary abdominal, when the ovum partially escapes by rupture of the sac; 7. Intra-ligamentous or extra-peritoneal, when the sac formed by the tube ruptures into the broad ligament, and the ovum develops between the layers of the broad ligament. To these varieties of extra-uterine fœtation must be added; 8. Pregnancy in an abnormal uterus, generally the rudimentary horn of a uterus unicornis.

Causation.—In some instances obstacles are discovered which may have impeded the course of the ovum, such as a small polypus at the mouth of the Fallopian tube, or a fibroid tumour. It is probable that in many cases the obstacle may consist in a twisting of the tube due to peritoneal adhesions, or to a constriction or atresia of the tube. Such conditions, however, cannot usually be verified by autopsy as having existed prior to impregnation, on account of the great alterations produced by the inflammation set up by the presence of the extra-uterine sac.

One morbid condition has often been found in the remaining parts of the tube of both sides in cases of tubal fœtation, namely, an endosalpingitis, with loss of the lining epithelium of the tubes. It is not improbable that this condition renders the ovum more likely to adhere to the wall of the tube. Its implantation there would then be somewhat analogous to its implantation in the uterus when the superficial layer of the endometrium, or at any rate the epithelium, has lately been thrown off in menstruation. Another theory of causation has been propounded by Webster, namely, that the fault lies in a congenital abnormality of the mucous membrane of the tube, which renders it susceptible to be stimulated by the presence of an ovum to produce decidual tissue, a peculiarity which ought to be limited to the mucous membrane of the uterus.

Clinical observation, however, tends to confirm the view that the cause is often some organic obstruction or morbid condition hindering normal pregnancy. For the subjects of ectopic fœtation are rarely very young, generally over thirty years old; and, in many cases, they have either lived for years in sterile marriage, or a good many years have elapsed since the last pregnancy. There is another curious mode of origin which appears to occur in women who have not shown any degree of sterility; namely, the interference of one ovum with another on their way to the uterus. According to Dr. Parry's * statistics, twin pregnancies are at least four times as common in extra-uterine as in normal fœtation: a proportion which proves that some causal relation must exist. It has been thought that the second ovum may be obstructed by the first in reaching the tube, and drop in consequence into the peritoneal cavity. Later authorities however have criticised these statistics, on the ground that not only twin pregnancies are included, but others, in which a uterine pregnancy has subsequently occurred, with an extra-uterine fœtus still retained in the abdomen.

Pathological anatomy.—The pathological anatomy and usual course vary in different varieties.

Ovarian fœtation.—The possibility of ovarian fœtation has been denied. It is undoubtedly very rare, but Spiegelberg considers that thirteen recorded cases satisfy the necessary criteria for proof, including the presence of ovarian tissue in the wall of the sac. It is probable however that some cases which were regarded as ovarian, from the position of the sac being similar to that of an ovarian tumour, without any peritoneal adhesions, were really intra-ligamentous, since the latter variety has been found to be comparatively common. Ovarian tissue may in such a case be found in the wall of the sac, from the ovary having become spread out upon its surface. Cases of advanced pregnancy are not decisive, since the tube is not found intact at that stage, and no case of ovarian pregnancy at a very early stage has been reported. But there are a few which appear sufficiently to establish its possibility : the pregnancy having been at a comparatively early stage. Thus in a case reported by Porter,* a woman aged 28 years died from rupture when between six and seven weeks gone in her fourth pregnancy. At the necropsy the left tube was found free and pervious, but the left ovary, which contained the gravid sac, was as large as a hen's egg. Cases of comparatively early ovarian pregnancy in which the tubes were intact have also been described by Kammerer and Patenko, and two by Martin of Berlin. In the case of ovarian fœtation the Graafian follicle must have ruptured without escape of the ovum, so as to allow the spermatozoa access to the ovum in situ. The opening may either become closed as the sac grows, or a part of the ovum may escape through it, the placenta remaining within the ovary. It is generally stated that in the majority of cases ovarian pregnancy leads to rupture and hæmorrhage before the third or fourth month, but, that in some cases the pregnancy goes on to full term, like abdominal pregnancy.

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* "Extra-Uterine Pregnancy," by Dr. Parry.

Abdominal fœtation.—Of this there are two varieties, one in which the ovum escapes from the grasp of the tube, becomes fertilised, and implanted in the peritoneum ; a second, in which the pregnancy is at first tubal or in an abnormal uterus, the sac ruptures at an early stage, the embryo, or even the entire ovum, escapes, but continues to develop. Of late doubt has been thrown upon the existence of primary abdominal, as well as upon that of ovarian fœtation, but I have met with one case which appeared open to no other explanations.† Rupture took place at seven weeks' gestation, and the patient died after operation. The embryo was found, and measured $\frac{5}{8}$ inch in length. Both tubes were free and pervious, the fimbriæ normal, and showed no sign of any recent dilatation. The fœtal sac was attached to the bottom of the pouch of Douglas, and was adherent to the back of uterus and broad ligament. Its attachment was two inches away from the nearest ovary. The wall of the sac had a smooth outer surface which microscopically resembled in structure the peritoneal surface of the broad ligament. This sac-wall can only be explained as being a structure corresponding to decidua reflexa, formed from the peritoneal surface. This specimen was examined by a committee of the Obstetrical Society of London, who reported that it was probably a case of primary abdominal fœtation. In any such case it cannot be proved that there was not a tubal abortion, after which the tube contracted again, and the detached ovum implanted itself on the peritoneum. But it is far more improbable that this should happen than that the ovum should attach itself primarily to peritoneum.

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* Amer. Journ. Med. Sciences, Jan., 1853.

† Obstet. Trans., 1896.

At any rate, primary abdominal fœtation is excessively rare, and probably can only occur if the peritoneal epithelium is in some way damaged. There is reason to believe that many at least of the cases reckoned as primary abdominal fœtations were really cases of intra-ligamentous fœtation, in which the peritoneum was stripped either off the back of broad ligaments and uterus, or off the anterior abdominal wall, or in which the sac had become adherent to intestines. In such instances, there may appear, at first sight, to be a primary attachment of the placenta to the peritoneal surface of uterus, abdominal wall, or intestine.

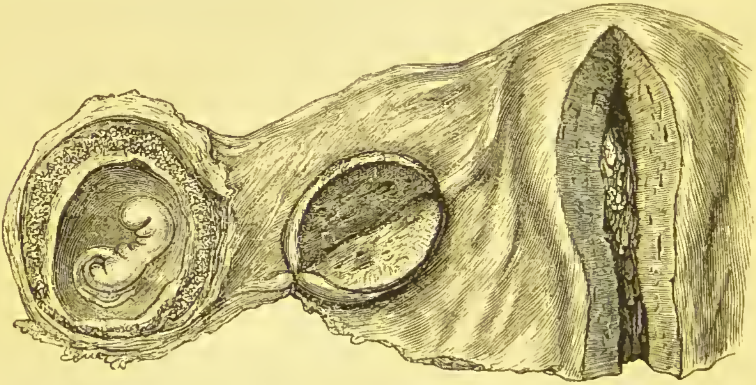

Fig. 125.—Tubal fœtation. Decidua in uterus partly separated.

Tubal fœtation.—Tubal fœtation is the commonest of all the varieties. The wall of the tube forming the sac becomes hypertrophied to some extent, but is not able to grow with the ovum. It therefore becomes thinned, usually at the part furthest from the attachment to the broad ligament, and eventually bursts, causing hæmorrhage which is severe and very often fatal. The rupture takes place usually at from two to eight weeks' growth, more rarely in the third month; a few cases are on record in which a tubal fœtation has gone on till the later months, or even till full term. This is only possible when the muscular wall of the tube undergoes great hypertrophy, as it sometimes does also in cases of pyosalpinx or hydrosalpinx, becoming a quarter of an inch thick or more. The growing sac then separates the layers of the broad ligament, and comes to have a pedicle somewhat like that of an ovarian tumour formed by the stretched-out base of the broad ligament. Its position is therefore not unlike that of an intra-ligamentous pregnancy, except that it does not generally descend so deeply into the pelvis.

It is probable that rupture is sometimes precipitated by spasmodic contraction of the muscular fibres in the dilated tube. The embryo alone, or the whole ovum, may escape from the sac, or the whole may remain within it. In rare cases false membranes form a new sac around the escaped embryo, and pregnancy goes on. If the patient does not die from the effect of shock and hæmorrhage, peritonitis is set up by the effused blood. After a time, the blood clots, and the clots may be shut in by peritoneal adhesions. The mass may afterwards increase by further hæmorrhage within it. A retro-uterine hæmatocele is thus formed. The uterus is generally pushed forward and upward against the pubes. The mass behind the uterus may form a tumour reaching up to or above the umbilicus, and on vaginal examination is felt as a mass filling up the pelvis behind the cervix.

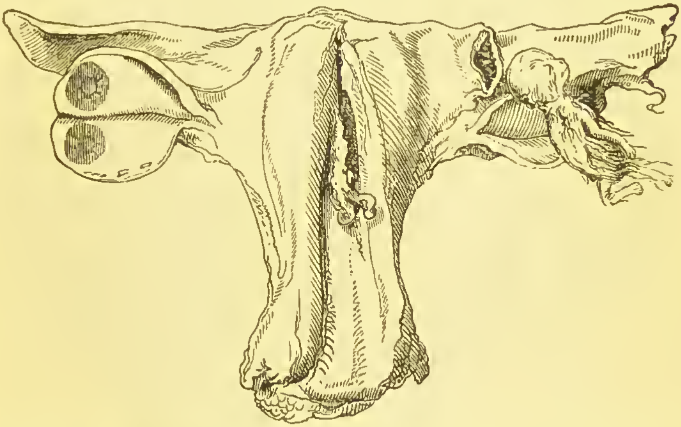

Fig. 126.—Tubal fœtation, with the corpus luteum in the ovary of the opposite side. The decidua is partially detached from the uterine cavity.

It is common in tubal fœtation for an apoplectic ovum (see Chapter XXII.) to be produced by effusion of blood among the villi, followed or preceded by death of the embryo. The increased tension so produced may be the immediate cause of rupture, or a tubal mole may result, which remains for a long time, but gradually shrinks. In other cases the placenta appears to continue for some time a kind of vegetative growth, so that a mass of considerable size, made up of villi and blood clot, may be found, without any embryo.

Tubal abortion.—In most cases the outer part of the tube beyond the ovum soon becomes closed, but in some instances it remains open for some weeks. The ovum, or a mass of clot formed by hæmorrhage into the ovum, constituting a carneous mole, may then be extruded by contractions of the tube into the peritoneal cavity, accompanied generally by a considerable quantity of blood. The case may then run the course of a hæmatocele, or the hæmorrhage may prove fatal, unless an operation is performed. The mass of clot may contain only a few traces of chorionic villi. In other cases none are found, and it is difficult to decide between tubal fœtation and hæmatosalpinx. But if a rounded mass of clot is found in

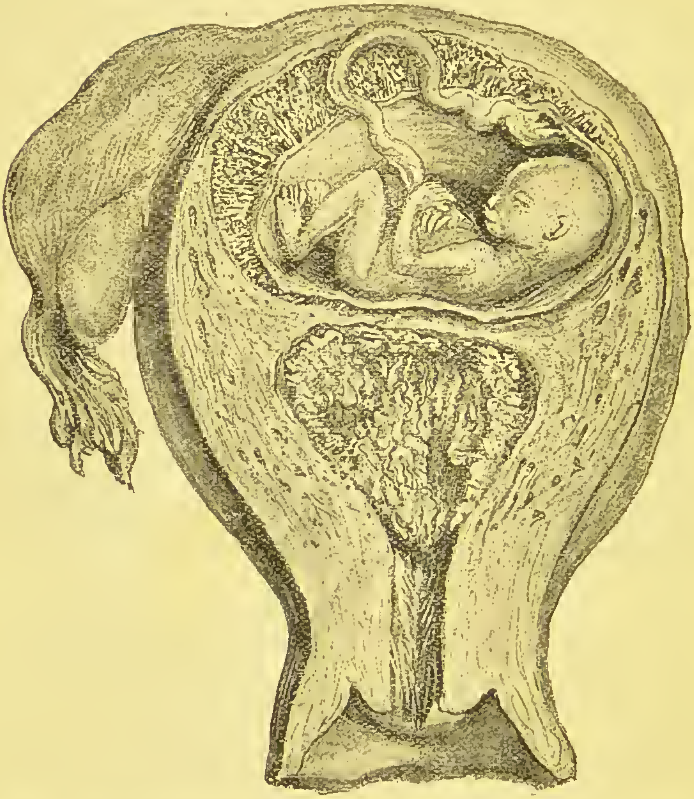

Fig. 127.—Tubo-uterine, or interstitial fœtation, from a specimen in the museum of Guy's Hospital.

one tube, the other tube being undilated, there is a probability in favour of tubal fœtation.

Some cases of tubal fœtation give evidence of transperitoneal migration of the ovum, or of the spermatozoa, from one side to the other. By the former, those cases are explained in which the corpus luteum is found on one side and the ovum in the opposite Fallopian tube (see Fig. 126, p. 299); by the latter, those in which ovum and corpus luteum are on the same side, but the portion of tube between ovum and uterus rudimentary, or evidently long impervious. The wandering of the spermatozoa across the peritoneal cavity by their own movements is not surprising. Nor is that of an ovum, if it be remembered that probably many ova fail to reach the Fallopian tube, and that some of these may happen to come within reach of the current of serum produced by ciliary action toward the orifice of the opposite tube. In very rare cases, it has been thought to be proved that the ovum reached the uterus and ascended the tube of the opposite side.

In *tubo-ovarian fœtation*, the ovum is arrested at the pavilion of the tube, which is already adherent, or which becomes adherent, to the ovary, and thus forms the fœtal sac. The course appears to resemble that of abdominal fœtation.

In *tubo-abdominal fœtation*, the ovum is attached to the pavilion of the tube, and the sac is completed by adhesion of the pavilion, after implantation of the ovum, to some portion of the peritoneum.

In *tubo-uterine* or *interstitial fœtation* (Fig. 127), where the ovum is arrested in the uterine portion of the tube, the sac as it enlarges most frequently projects outwardly at the angle of the uterus, becomes thinned at that point, and ruptures before the fourth month. More rarely the uterine tissue is developed sufficiently to allow pregnancy to go to full term. If the sac is near the uterine cavity, it may bulge into that cavity, and then the ovum may escape, or be extracted, through the natural passage.

In some cases of interstitial fœtation, the ovum has been thought to have been developed in an abnormal tube running in the wall of the uterus, and communicating with the Fallopian tube. Such a tube would be a portion of the Müllerian duct not blended with the duct of the other side, and may open into the uterus anywhere between the upper angle and the external os. The uterus would be really a more or less complete uterus unicornis, although externally it might appear normal.

Intra-ligamentous fœtation.—In this variety the pregnancy is primarily tubal, the tube ruptures on the side which is in connection with the cellular tissue, and development goes on in a sac formed between the layers of the broad ligament (Fig. 128). The wall of the sac may be thick, with a considerable layer of involuntary muscular fibre over its surface, or it may be thin. The attachment of the placenta becomes extended from its primary site in the tube to the cellular tissue lining the sac. It may occupy any part of the sac, sometimes its upper portion, near the original position of the Fallopian tube, sometimes its lower portion, beneath the fœtus, where it becomes attached deeply to the cellular tissue at the base of the broad ligament. As the ovum grows, it may peel the peritoneum either posteriorly off the back of the uterus and the other broad ligament: or it may extend anteriorly and peel the peritoneum first off the psoas and iliacus muscle, commencing at the anterior face of the broad ligament, and finally off the anterior abdominal wall from below upward. In other cases, but more rarely, the broad ligament is drawn out and a kind of pedicle formed from it, like that of an ovarian tumour. Much more frequently the sac burrows deeply into the broad ligament, and is widely attached to the cellular tissue of the pelvis, as shown in Fig. 128,

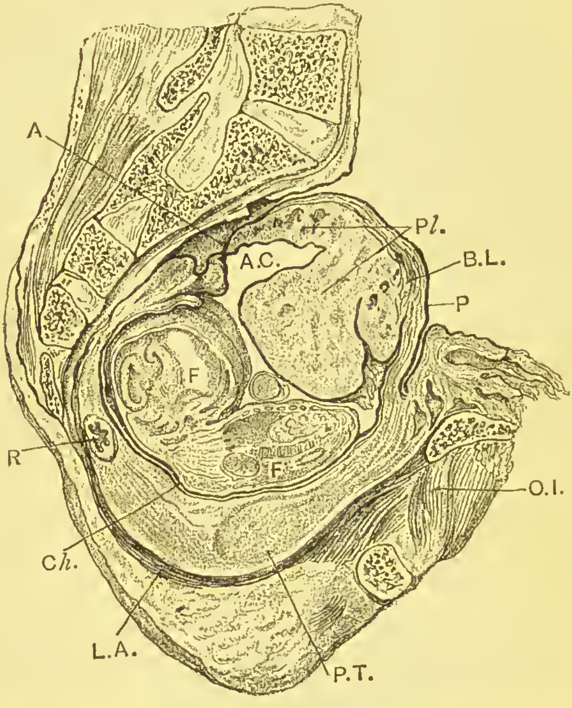

Fig. 128.—Sagittal lateral section of pelvis, with intra-ligamentous fœtation in right broad ligament. A, amnion; A.C, amnial cavity; Pl, placenta; B.L, broad ligament; P, peritoneum; F, fœtus; Ch, chorion; R, rectum; L.A, levator ani; P.T, paraproctal tissue; O.I, obturator internus. (After Hart.)

so that it is impossible, if an operation is performed, to make a pedicle, and remove the whole sac.

As a synonym to intra-ligamentous fœtation, the terms *subperitoneo-pelvic* and *subperitoneo-abdominal* fœtation are sometimes used, the former when the sac is contained wholly in the pelvis, the latter when it lies partly above the pelvic brim. Since the difference depends merely upon the age and size of the ovum the term which includes both cases appears to be preferable.

The fœtus may go on developing up to full term, or may die from imperfect nutrition, without any further rupture, at any time during the course of pregnancy, generally within the last two months. In some cases, the peritoneum remains free from inflammation throughout; in others, peritonitis is set up, and the peritoneal surface of the sac becomes adherent to pelvis, intestines, or abdominal wall.

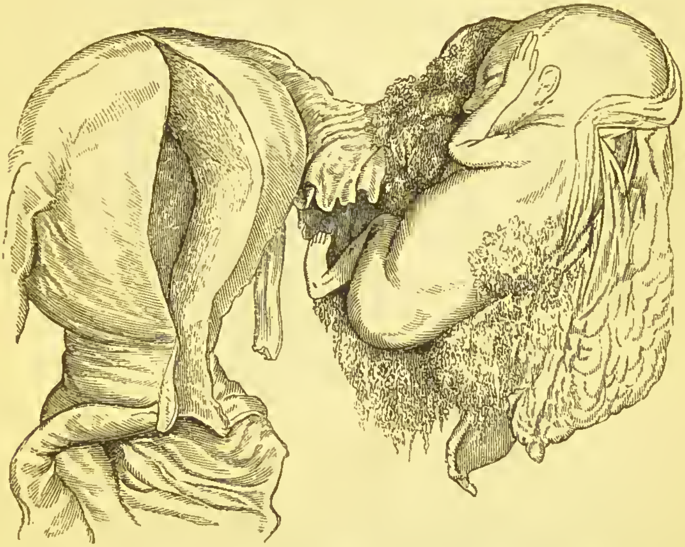

Fig. 129.—Uterus and fœtus from a case of (? secondary) abdominal fœtation. The placenta is connected with right broad ligament.

In other cases, again, *secondary rupture* into the peritoneal cavity occurs, generally in the third or fourth month. If the ovum dies, the patient may die from hæmorrhage, if not saved by abdominal section, or may survive with the formation of a hæmatocele. If it continues to live, secondary abdominal fœtation is the result.

Secondary abdominal fœtation.—Secondary abdominal fœtation may possibly occur from primary rupture of the tube into the peritoneal cavity: but probably it is generally the result of secondary rupture of an intra-ligamentous pregnancy, when the placenta has already acquired an attachment to cellular tissue. The broad ligament then continues to be the placental site, while the fœtus escapes into the abdomen. Generally more or less chronic peritonitis continues during the course of pregnancy and the fœtus becomes enclosed in an adventitious sac of lymph. Sometimes there is no peritonitis, and the fœtus is found enclosed merely in its membranes, amnion and chorion, or amnion only. Or again, the membranes may rupture, and the fœtus be quite free among the intestines, the liquor amnii being absorbed by the peritoneum. The placenta sometimes forms an elastic mass, toward one side, separate from the fœtus, and simulating an ovarian tumour. Pregnancy may go on to full term, or the fœtus may die from imperfect nutrition or from pressure at any time during the course of pregnancy. The presence of muscular fibres makes it more likely than in most other forms that the placenta should become detached by contractions of the sac in the false labour.

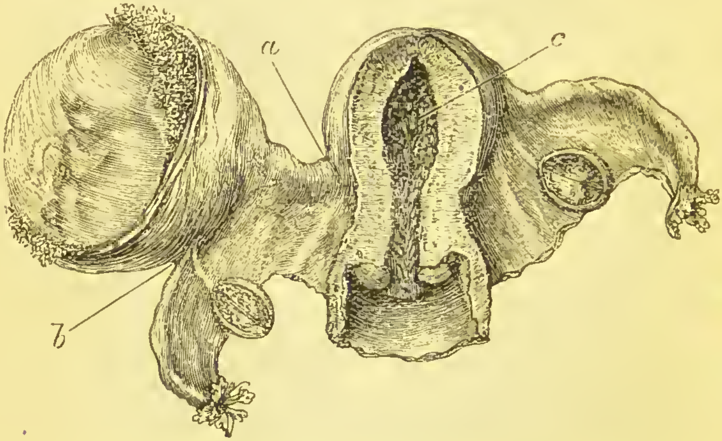

Fig. 130.—Pregnancy in rudimentary uterine horn. *a*, junction of rudimentary horn with uterus; *b*, point of origin of round and ovarian ligaments and Fallopian tube, toward outer part of ectopic sac; *c*, uterus unicornis dexter.

In all the forms of extra uterine fœtation, the most favourable result is for the embryo to die at an early stage. This appears to be not uncommon, but in most cases of the kind, the diagnosis is never absolutely verified.

Pregnancy in a rudimentary uterine horn (Fig. 130) may either lead to rupture in the early months, but probably not quite so early as a tubal pregnancy: or the fœtus may go on developing up to full term. In the latter case, the pregnancy may be marked by no abnormal symptoms, until full term arrives, or some peritonitis may occur in the course of pregnancy. In one such case, that of a primipara, I removed the whole tumour unopened after full term, tied the base like an ovarian tumour, after separating extensive adhesions, and the patient recovered as quickly as from an ovariotomy. Within a year, she had had a second child, developed in the remaining half of the uterus, and normally delivered.

Of the cases in which one fœtus has been in the uterus and one extra-uterine, a considerable proportion has gone on to full term without producing grave symptoms, and the extra-uterine tumour has been discovered only in labour or after delivery. In some the extra-uterine sac has ruptured, or hæmorrhage has taken place internally.*

In all forms of ectopic fœtation, the uterus becomes considerably enlarged, and a decidua forms in it. In tubal fœtation, the uterine enlargement is greater the nearer the sac is to the uterus. When the fœtus dies, involution of the uterus commences. Progressive enlargement of the uterine cavity is, therefore, important evidence of continued life of the fœtus. When pregnancy goes on to the later months, the child is occasionally well formed, but more often it is smaller and less nourished than in uterine pregnancy, and deformities, the result of pressure, are common, especially in abdominal pregnancy. If the fœtus dies before full term, the contents of the sac may become decomposed, or suppuration may occur in it. The patient may then suffer from septic absorption. The decomposition in the cyst, notwithstanding the exclusion of air, is probably to be attributed to germs making their way from the intestines, which are often in close vicinity. More rarely the sac may rupture into the peritoneal cavity, or hæmorrhage may occur from partial detachment of the placenta, the blood either making its way into the sac, or, if there is no adventitious sac, reaching the general peritoneal cavity.

When full term is reached, if the child is alive up to that time, a kind of sham labour often takes place; uterine contractions, accompanied by action of the auxiliary muscles of labour, occur, and separate and expel the uterine decidua. This leads to a sanguineous discharge lasting several days. The child dies within a few days from the onset of this sham labour. In other cases the decidua is expelled before the full term, especially if the child has died previously. It is but rarely that rupture of the sac is caused by the sham labour, but some hæmorrhage may take place into it. In most cases, after death of the child, sufficient decomposition takes place in the sac to cause inflammation and suppuration, either at once or after some interval. Its contents may then escape either externally, by the rectum, the vagina, or the bladder. Of these the external opening is most favourable, that into the rectum the commonest. The process of evacuation may be prolonged even for years, if not assisted artificially, the bones coming away piecemeal. Eventually the patient may recover.

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* As in a case recorded by the author. Obstet. Trans., Vol. XXIII.

In other cases decomposition does not take place, but the fluid in the sac is absorbed, and the fœtus becomes mummified, or gradually changed into adipocere. The sac and fœtal membranes may become calcified from deposit of lime, a process which aids in isolating the fœtus and rendering it innocuous. In some cases the fœtus itself becomes more or less calcified, and is then called a "lithopædion." Generally only the integument is actually hardened, but deposit of lime takes place in the interior also.* A mummified or calcified fœtus may be retained for many years (in one case as long as forty-nine years) and other pregnancies may occur and go on to a normal issue. Inflammation of the sac is, however, liable to occur at any time.

The placenta in extra-uterine fœtation.— According to Webster, the trophoblast derived from the fœtal epiblast attaches itself to the maternal tissues in the same way in tubal as in uterine pregnancy. A decidua serotina is formed containing characteristic decidual cells. The maternal blood-spaces appear to be formed in much the same way as in uterine pregnancy. It is probable, however, that they are not always so completely developed; and with this agrees the fact that the placenta is often thin, but spread out over a large surface.

In one case of intra-ligamentous pregnancy after full term, while there was still maternal circulation through the placenta, I was able to strip the chorion from the placenta without hæmorrhage, cutting the main trunks of fœtal vessels. The maternal sinus system could not therefore have extended up to the chorion. A decidua vera is formed to a variable extent in the immediate neighbourhood of the ovum, but is much less extensive relatively, and less developed, than in uterine pregnancy. A decidua reflexa is not generally found, but has been discovered in a few specimens. It is probable that it only occurs when the lumen of the tube is relatively large, and that, otherwise, the ovum becomes immediately attached to the tube on all sides. The case reported at p. 297, seems to show that a decidua reflexa may be formed in primary abdominal pregnancy, which in consequence may appear, at first sight, to be subperitoneal. A decidua is formed also in the uterus, and may be detached and expelled either during the pregnancy or on the death of the fœtus.

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* "Note on the so-called Lithopædion," by Dr. R. Barnes. Obstet. Trans., Vol. XXIII.

Symptoms.—In tubal pregnancy, if rupture takes place early, the first sign of anything wrong is often the sudden attack of agonising pain, with collapse and signs of internal hæmorrhage. There may or may not have been arrest of menstruation, and vomiting or other signs of early pregnancy. If rupture is deferred beyond six or eight weeks, general symptoms of pregnancy usually exist, and attacks of acute spasmodic pain, attributed to contractions of the tube, often occur. Generally there is amenorrhœa for a time, but irregular discharges of blood are apt to take place, especially in conjunction with the spasmodic pain. Sometimes, in place of amenorrhœa, there is a slight continuous sanguineous discharge from the commencement of pregnancy. In some cases rupture occurs by a small opening. There may then be repeated milder attacks of abdominal pain with symptoms of shock, followed perhaps by a more intense one. In abdominal, or intra-ligamentous, pregnancy the general signs of pregnancy, including amenorrhœa, are generally present. Sometimes nothing abnormal is noted till full term, or the death of the fœtus, when the false labour, and expulsion of decidua from the uterus, followed by a kind of lochial discharge, supervene. More frequently unusual abdominal pain is felt, especially on movement of the fœtus; and in abdominal pregnancy attacks of peritonitis usually occur; or the whole of pregnancy may be a course of subacute peritonitis. In intra-ligamentous pregnancy there are often pressure symptoms, if the sac descends low into the pelvis. If the sac is on the left side, more or less intestinal obstruction may be produced, by the sigmoid flexure being distended over it. After death of the fœtus there are frequently the constitutional signs of inflammation of the sac, peritonitis, and septic absorption. There may be previously irregular bleeding and expulsion of a uterine decidua, but not so frequently as in tubal fœtation.

Diagnosis.—Diagnosis in the early months is often very difficult. Tubal fœtation may be suspected if there are general signs of early pregnancy, accompanied by attacks of spasmodic pain, and irregular hæmorrhage, and if a tumour of corresponding size is felt at one side of, or behind the uterus. Ballottement may possibly be discoverable somewhat earlier than in normal pregnancy, as in a case recorded by Professor Thomas of New York. If a swelling is detected at the side of the uterus, not yet advanced enough to give signs of fœtal life, and if a manifest souffle is heard over the swelling, there is a strong presumption in favour of extra-uterine fœtation. The cervix uteri, in the early months, will probably resemble that of ordinary pregnancy, and the uterus will be enlarged, but not so globular as in uterine pregnancy. Its position varies, but generally it is pushed to one side and forward, the sac lying rather behind it. If there is a strong presumption in favour of extra-uterine pregnancy, sufficient to make it justifiable to run the risk of inducing abortion, the diagnosis may be confirmed by passing the sound into the uterus, and making out that it is empty. The use of a tent is not desirable, as it appears sometimes to be the starting-point of rupture or inflammation of the sac. It is safer not to use even the sound, until the physician is prepared to operate, in case the diagnosis is confirmed. A sudden attack of faintness and collapse, with signs of internal hæmorrhage, commencing with sharp pelvic pains, will justify a probable diagnosis of ruptured tubal fœtation, especially if menstruation has been arrested for a few weeks. A small lump at one side of the uterus may perhaps be discoverable only if an anæsthetic is given for the examination.

In the later months, when the fœtation will generally be of the abdominal or intra-ligamentous variety, the presence of a living fœtus would be ascertained by auscultation and palpation. A souffle like the uterine souffle, may be heard, but not so constantly as in normal pregnancy. The difficulty will now be to distinguish between extra-uterine and uterine pregnancy. The apparently superficial position of the fœtus is an unreliable sign, for this may simply result from thinness of the uterine wall. In the later months the cervix will generally be less softened than in normal pregnancy, but in some cases the softening is so considerable that this distinction fails. The enlargement of the uterus does not continue to increase beyond three or four months. The diagnosis may be made absolute, if the uterus can be made out as separate from the sac containing the fœtus. On the other hand, if marked changes of firmness and laxity are manifest in the sac containing the fœtus, the sac is almost certainly the uterus. As before, if the case is very critical, diagnosis may be completed by use of the sound. Not unfrequently the cervix becomes patent enough to allow the finger to pass and ascertain the emptiness of the uterus, especially about the time of the expulsion of the decidua. Recognition of a piece of decidua passed from the uterus is also often a valuable aid to diagnosis. The placenta, if in front in abdominal fœtation, may sometimes be made out separately from the fœtus, as an elastic fluctuating tumour, generally corresponding to one broad ligament. In intra-ligamentous pregnancy, the placenta may sometimes be made out to be at the top of the sac, and some part of the fœtus may be felt low down in the pelvis, with no placenta intervening. The uterus will be more or less pushed over to one side, though the sac may extend in front of, or behind it. Abdominal fœtation may sometimes be distinguished from intra-ligamentous by the placenta forming a separate tumour distinct from the fœtus, and by more marked signs of peritonitis during the course of the pregnancy. The parts of the fœtus may also, in some cases, be felt more superficially, and pain will be produced when they are handled.

In the case of combined extra-uterine and uterine pregnancy, diagnosis from pregnancy complicated by a tumour is very difficult, and can only be made by recognising fœtal life in both tumours.

If the patient is only seen after the death of the fœtus, the distinction will have to be made between extra-uterine fœtation and an ovarian or uterine tumour, and must depend chiefly upon a history of pregnancy, not ending in delivery. Since histories are often unreliable, it may be impossible to make an absolute diagnosis, except by exploratory incision.

If, when abdominal section is performed in the later months, a free peritoneal cavity is opened, and the sac is found to be also covered by peritoneum, the pregnancy must be either intra-ligamentous or advanced tubal. The latter can only be distinguished by the presence of a more definite muscular wall, below, as well as above, and continuous with the wall of the Fallopian tube.

Tubo-uterine fœtation is distinguished from tubal by the absence of any portion of tube between the sac and the uterus, and by the origin of the round ligament being outside the sac. In pregnancy in a rudimentary horn, the origin of the round ligament is also outside the sac, but the sac is not continuous with the uterus.

Prognosis.—Extra-uterine fœtation is almost always fatal to the child, and very dangerous to the mother. Almost all the cases in which tubal fœtation has been positively ascertained have, until lately, been fatal (97 per cent., Puech). Of late, however, a considerable number of cases have been saved by abdominal section, mostly after rupture of the sac; but, in a few cases, when a diagnosis has been made in the first few weeks of pregnancy, before rupture. It is probable that a large proportion of cases of retro-uterine hæmatocele, which often run a favourable course, are really due to rupture of an early tubal fœtation or to tubal abortion. In intra-ligamentous or abdominal fœtation, reaching the later months, the mortality is still very high. According to Parry, it was 52·6 per cent. in 183 cases left mainly to nature, 38·8 per cent. in 36 cases treated by secondary abdominal section. Litzmann's statistics, which include more recent cases, give a mortality of 42·4 per cent. in 33 cases of secondary abdominal section.

Treatment.—In order to destroy the fœtus in the early stage various means have been used, such as to pass through it shocks from a Leyden jar, or a Faradic or galvanic current, to puncture the sac and draw off the liquor amnii, to puncture and inject morphia or atropine. Though the plan of puncturing is tempting, yet, according to Parry, the mortality after its use is as high as 77 per cent., and the fœtus not always killed. If the fœtation is diagnosed as tubal, and not beyond two or three months' development, there is no doubt that, in the hands of a skilled specialist in abdominal surgery, an exploratory incision through the abdominal wall is safer and better treatment, for, at that stage, it may be expected that the whole sac will be free from adhesion, and capable of removal. Even if there is only a probability of extra-uterine fœtation, and a lump is felt near the uterus, it is justifiable, having regard to the extremely dangerous character of the affection, to perform an exploratory abdominal section. Repeated use of a strong Faradic current, one pole being applied close to the sac by rectum or vagina, the other placed on the abdominal wall, has been reported as successful in causing the death of the ovum in a number of cases, chiefly in America. This plan may be tried without much risk. Its efficacy is, however, open to doubt, and time should not be lost in trying it in the early stage of pregnancy at which the prospect of abdominal section is so hopeful. For the reported successes have been in the early months, before there is evidence of the fœtal life, and when, therefore, there is a possible or even probable doubt as to diagnosis. It is to be remembered also that an extra-uterine ovum often dies spontaneously. On the other hand, electricity has failed entirely to kill the fœtus, after its life is demonstrated. Matthews Duncan reported a case in which a current was used strong enough to peel the skin off the fœtus. The mother died, but the fœtus lived to the last. In one case, in the fifth month, after repeated use of a Faradic current as strong as the patient could endure it, I employed for some time, under anæsthesia, a current so strong that both legs were tetanised by the induced current in the sciatic nerves. But the fœtus was none the worse.

If there are symptoms of rupture and hæmorrhage, the correct treatment is to perform abdominal section, wash or sponge out the blood, and arrest the bleeding. Within the first two months or so of tubal fœtation, it will probably be possible to transfix the base of the sac with a blunt pedicle or aneurism needle, armed with carbolised silk as used for ovariotomy, tie it in two or more loops, and remove the sac as a whole.

Even after the second, and up to the middle months of pregnancy, as soon as a diagnosis of extra-uterine fœtation can be established, the best treatment appears to be to perform abdominal section. For it may still prove to be possible to place ligatures under the base of the placenta and remove the whole ovum; or, if this cannot be done, yet while the placenta is of small size, there is a better hope that the patient may survive the risks of hæmorrhage and septicæmia involved in its subsequent separation. It is not desirable to wait in the hope of saving the child. For the chance of obtaining a living and perfect child is but small; and where the risk to the mother is so extreme, her interest is paramount.

From the middle up to the end of pregnancy, it is a more difficult question whether to perform a primary operation while the child is alive. The risk of the operation is enormous. For, in abdominal or intra-ligamentous pregnancy, it will generally be impossible to ligate the base of the placenta. Unless this can be done, it is now the accepted principle to leave the placenta untouched at the operation, if possible. The attempt to separate it generally causes fatal hæmorrhage, the placental site being unable to contract and close the vessels. But this does not avoid all the difficulties. The placenta has to decompose and come away. If rapid decomposition occurs, there is a current of maternal blood passing through decomposing tissue, and almost inevitable sapræmia or septicæmia (see Chapter XXXIX.). The decomposition is also likely to lead to early separation of placenta and hæmorrhage. Even late decomposition of the placenta produces more or less septic absorption, and hæmorrhage occasionally takes place on separation, even as late as several weeks after the removal or death of the fœtus. Again there may be no adventitious sac, firm enough to stitch to the abdominal wall, and septic matter from the placenta will then enter the peritoneal cavity and set up peritonitis.

With the improvement of abdominal surgery, however, the tendency is rather in favour of the primary operation; and, in a few cases, both mother and child have been saved. If, however, the full term of pregnancy is nearly reached; or if, at any time, the child appears to be dying, it is probably better to try to wait till at least a month after its death, if the general condition of the patient does not become serious.

If the child is dead, especially if it has been dead for some weeks, the prospect of the operation is very much more favourable, for the placental circulation will have diminished or may have ceased. It is better to operate than to wait for the chance of a lithopædion being formed, or of nature's safely evacuating the fœtus. Even then, however, if the constitutional condition is not alarming, it is preferable to wait for at least a month after the death of the fœtus, that there may be less risk of hæmorrhage on detachment of the placenta. If, however, the constitutional condition indicates a septic change within the sac, immediate operation is likely to give the only chance of saving the patient.

Operation.—The first essential is to avoid wounding the placenta. The site of incision should therefore be where some fœtal part is felt so distinctly that there cannot be placenta over it. If such a site cannot be found in the median line of the abdomen, the incision may be made anywhere else. The sac being opened, the fœtus is to be extracted by the leg, or the head may be seized, if it happens to lie near the incision. An assistant should be deputed to see to the infant, and perform artificial respiration if necessary. The funis may be tied on the fœtal side and divided at once, care being taken to make no traction upon it. The blood should be allowed to flow from the placental end, so that no more than necessary may be left in the placenta.

The most favourable chance is when the fœtation is intra-ligamentous, especially if the placenta is at the upper part of the sac. It may then be possible to turn out the whole sac, after the fœtus has been removed, and treat it like an ovarian or broad ligament cyst, which extends deeply into the broad ligament, namely, to pass strong silk ligatures deeply underneath it, and tie the base in sections. The whole sac and placenta may then be removed. If this cannot be done there is likely at any rate to be a thick-walled sac which can be stitched to the abdominal wound, any redundant portion of it having first been removed. The same treatment should be adopted also in abdominal fœtation, unless there appears to be a chance of ligaturing the base of the whole placenta. The upper part of the wound is to be closed, so that the peritoneal cavity is shut off, but about two inches are to be left open at the lower extremity to allow free drainage from the sac. The funis may be fixed in the opening, the superabundant portion of it having been cut away, and a large drainage-tube placed by the side of it. Some iodoform may be dusted into the sac, the sac plugged with iodoform gauze, and the dressing left untouched for several days at least, if the patient's condition remains favourable. Afterwards antiseptic irrigation should be used at intervals, say with chinosol 1 in 2000, or Tinct. Iodi. ℨi. ad Oi. The placenta will probably have to be removed piecemeal, when it begins to break up, which it generally does in about a week. If bleeding occurs on its separation, it is better to remove the whole, and plug the sac with iodoform gauze.

If there is no sac which can be stitched to the edges of the wound, the only thing which can be done is to leave a large drainage-tube in the wound, its lower end near the placenta. Care must be taken to free it from time to time, if it becomes blocked by lymph, and not to allow the opening to close till the placenta has been discharged, even if the patient appears to be doing well for the first week or two.

If the placenta is wounded at the operation, or has become partially detached before, the prospect is very unfavourable. Probably the best chance is first to place a ligature deeply on the outer part of the broad ligament, if the placenta seems to be connected with that structure; then to separate the placenta rapidly, if this can be done, and plug with a long strip of iodoform gauze. If the gauze has to be left in the peritoneal cavity, not merely within the fœtal sac, the end of the strip may be brought out through the abdominal wound, and the whole removed by its means after twenty-four hours. The plugging may be facilitated by using what is known as the Miculicz tampon. A bag is made of the gauze, of a size suitable to fill the pelvis. Strips of gauze are then packed inside the bag, and by means of the bag are easily removed when required.

In abdominal pregnancy it is sometimes possible to open the sac without opening the general peritoneal cavity. The outlook is then somewhat more favourable.

In a case of doubtful diagnosis, when the patient is first seen some months or more after the full term of the supposed pregnancy, the right treatment, as a rule, is to clear up the diagnosis by exploratory incision. The fœtus or the tumour, as the case may be, can then generally be removed.

When the sac has suppurated, and bones begin to escape either externally, or through some internal cavity, as the rectum, vagina, or bladder, nature should be aided in the evacuation. So far as possible, the opening should be enlarged by stretching rather than cutting. For this purpose, tents will sometimes be found useful. An anæsthetic being given, the bones may then be extracted by finger or forceps.

In some cases, an extra-uterine fœtus has been successfully removed through the vagina. This operation should only be undertaken when the sac bulges toward the vagina, and when some fœtal part can be felt at the accessible portion of it. This will give some security that the placenta is not situated there. In the absence of such evidence, it is very likely to be found so placed. Here, again, the most favourable case is that of intra-ligamentous pregnancy, when the placenta will probably be at the top of the sac. The sac may be opened by the knife of the benzoline or galvano-cautery to diminish the risk of hæmorrhage. This method will not, however, avail to do so, if the placenta is the part first encountered. The placenta should be left untouched as in the case of abdominal section. It may be necessary to extract the fœtus by forceps or craniotomy. The sac should be plugged with iodoform gauze in the first instance, and afterwards regularly washed out with antiseptics, and it may be useful to insert a large drainage-tube into it.

Four Classes. Disorders

1) From Reflex Nervous influence
2) " Mechanical effects
3) " Morbid conditions of Uterus & ovum
(4 " Diseases independent of pregnancy but influenced

CHAPTER XX.

DISORDERS OF PREGNANCY DUE TO REFLEX AND MECHANICAL CAUSES.

The disorders of pregnancy may be divided into four classes—(1). Those arising from reflex nervous influence, associated with the changes in the nervous centres induced by pregnancy, and the general changes in nutrition which it causes. (2). Those which result from mechanical effects. (3). Morbid conditions of the uterus and ovum. (4). Diseases independent of pregnancy, but of such a nature that the disease is influenced by the pregnancy, or the course of pregnancy by the disease. In some cases, such as puerperal convulsions, the disease may have a complex causation, depending upon more than one of the above causes.

Many of the disturbances which come under the first class are exaggerations of those reflex symptoms of pregnancy which may be regarded as normal, or scarcely morbid. They depend not only upon the presence of a certain source of irritation in the pregnant uterus, but upon the increased irritability of the nervous centres which is associated with pregnancy. This increased irritability itself may be regarded as physiological, when within due limits, but in persons of highly excitable neurotic temperament, it may become excessive. The process of labour calls for unusual discharges of central nerve energy under the reflex stimulus of the pelvic nerves. In preparation for this, the nervous centres acquire an increased tendency to discharge energy by an eccentric stimulus. When any morbid tendency exists, which at other times may remain in abeyance, there is undue instability of the centres, and the discharges may take a morbid form, such as hysterical manifestation, neuralgia, vomiting, or convulsions.

Nausea and vomiting.—The well-known morning sickness, which is generally chiefly observed in the second, third, and fourth months, and passes off in the later months, has been already described among the signs of pregnancy. But in some cases the neurosis takes a much more severe form. The vomiting may not be limited to the morning, but occur at all times in the day, and it may persist in the later months of pregnancy. In extreme cases all food taken may be quickly rejected. There may also be, in addition, such a continual feeling of nausea that all appetite is destroyed.

Causation.—The disorder is to be regarded as one of the reflex neuroses associated with the increased irritability of nervous centres. The special source of irritation appears to be the stretching of the fibres of the uterus in consequence of its growth. Thus vomiting is more marked in primiparæ, in whom the resistance to expansion may be presumed greater; and it has sometimes been found to be excessive in cases where there has been an unusually rapid expansion, such as those of twin pregnancy, hydrops amnii, or vesicular mole. Again, vomiting is sometimes found to cease when the fœtus dies, although it is retained for a time within the uterus. The cause cannot, however, be passive distension by the ovum, since the ovum does not completely fill the uterus in the months during which vomiting is most marked. Women who suffer severely in this way are generally those of highly susceptible neurotic temperament. Frequently they have previously suffered from some uterine disturbance, such as dysmenorrhœa. Some authorities have ascribed the cause of excessive vomiting in pregnancy to special morbid conditions of the gravid uterus, such as anteflexion, or inflammation and erosion of the cervix. Erosion of the cervix, however, is more common in multiparæ, as the result of previous parturition, while vomiting is more marked in primiparæ. None of these explanations can be accepted as being generally true. But it must be admitted that the neurosis may be aggravated by any morbid condition of the uterus which would render the uterine nerves more susceptible to irritation, whether this be previous endo-metritis or metritis, inflammation of cervix, grave displacement, such as retroversion or retroflexion, or any other condition. For instance, vomiting is sometimes relieved upon the replacement of a retroverted gravid uterus. But such a case is exceptional, both among instances of retroversion of the gravid uterus, and among those of vomiting of pregnancy.

In some instances painful emotion or sudden mental shock is the starting-point of a very severe kind of vomiting. In other cases, the tendency to vomiting due to chronic dyspepsia, especially that produced by alcoholism, or Bright's disease, is added to the effect of pregnancy, and greatly aggravates it.

In some of those rare cases in which the vomiting of pregnancy terminates fatally, degeneration of the cells of liver and kidneys has been described as discovered *post mortem.* On this ground it has been supposed that such fatal cases of vomiting are altogether different in their nature and causation from the milder degree of the vomiting of pregnancy. It may be, however, even in such cases, the same causation may be at work, but that the degeneration of viscera predisposes to the fatal result.

Symptoms and course.—In some cases, although the vomiting is excessively distressing, yet the general nutrition does not seem to suffer much. This is especially the case when the vomiting is not continued throughout the whole day. In more severe cases symptoms of starvation appear. The patient becomes emaciated and weak, the tongue glazed and irritable, the urine scanty, the breath fœtid, and often there is a want of sleep. In the later stages elevation of temperature or delirium may occur. In some cases the urine becomes albuminous. The depravation of the blood and general weakness predispose to septicæmia, which is liable to arise after either spontaneous or induced abortion. Spontaneous abortion is apt to be deferred until the patient is almost moribund, and does not then save her life. If it occurs before symptoms are very grave, she generally quickly recovers.

Prognosis.—Cases which endanger life are very rare in comparison with the number of women who suffer, but they are not absolutely so excessively uncommon. McClintock collected nearly 50 fatal cases; Gueniot 46; R. Barnes had himself seen 9. When the pulse rises above 120, when delirium occurs, or diarrhœa supervenes at a severe stage, the danger is great.

Treatment.—In mild cases, in which simply the ordinary morning sickness is unusually troublesome, it is important that the patient should take a little food before getting up. This relieves the exhaustion which may promote the instability of the nerve centres, and gives the stomach occupation in a right direction.

Constipation, when it exists, should be treated. When there is a foul tongue, a dose of calomel occasionally is of service, and bismuth with bicarbonate of soda, or bicarbonate of potash with calumba and hydrocyanic acid may be given before food. Often an acid with a vegetable bitter after food * assists digestion and relieves vomiting. If any special lesion, such as granular inflammation of the cervix, exists, the effect of local treatment to it should be tried. Thus occasional painting of the cervix with concentrated tincture of iodine is often beneficial. Retroversion or retroflexion of the gravid uterus should be remedied, whether there is vomiting or not. Drugs innumerable have been recommended, and not unfrequently all are found to fail. Among these may be mentioned effervescing mixtures with hydrocyanic acid, pepsine or ingluvin after meals, oxalate of cerium, which may be given in doses of from five to ten grains, creasote, tincture of nux vomica, vinum ipecacuanhæ in doses of one minim every hour or every two hours, tincture of iodine in minim doses, compound pyroxylic spirit in five minim doses, caffeine, nitrite of amyl by inhalation. Among the most likely to be useful are remedies which are found to be of value in sea-sickness, such as bromide of potassium in full doses, and nitroglycerine in tablets, containing each $\frac{1}{100}$ grain. Iced champagne with milk is sometimes retained, but if there is any suspicion of tendency to alcoholism, recourse to alcohol as a remedy should be checked, since it aggravates the complaint.

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* Acid nitro-hydrochlor. dil. ♏xv.; Tinct. Gentian. co. ʒj.; Aq. ad ℥j.

In severe cases position and diet should be specially attended to. The patient should be kept recumbent, and liquid nourishment should be given at short intervals, only a spoonful at a time. Iced milk with soda-water or barley-water, or meat jelly, may be tried. Brand's essence of beef is often retained when milk is rejected. Barff's kreochyle is also valuable. Being peptonised, it is quickly absorbed, even when nothing can be retained long in the stomach. Fifteen minims of tincture of opium, given by rectum, or a small subcutaneous injection of morphia and atropia, are often useful; but, with a patient susceptible to morphia, this may rather do harm. Sulphate of atropia, $\frac{1}{60}$ grain, given by subcutaneous injection, sometimes appears to be of more use than any other remedy. In other cases small doses of morphia given by the mouth, and repeated whenever vomited, prove of great use. Counter-irritation over the stomach sometimes does good, and some recommend Chapman's spinal ice-bag, applied to the cervical vertebræ. The patient should not be allowed to become much emaciated before recourse is had to nutrient enemata. These should either consist of artificially digested food, or pancreatic extract should be added to them to procure digestion in the rectum.*

The most radical treatment is of course the induction of abortion. But before having recourse to this, if danger is not too extreme, it is often worth while to try the plan recommended by the late Dr. Copeman, of Norwich, namely, dilatation of the cervical canal. If the cervical canal is already somewhat patulous, this may be effected by pressing the index-finger into it; if not, metallic bougies may be passed into the canal, but not farther than just up to the internal os. This remedy must be regarded as an empirical one. The only rational explanation of it is, that the uterine tension acts especially on the nerves about the internal os, and that its effect is diminished by partial dilatation of that orifice. Since any effectual dilatation of the cervix has a strong tendency to bring on abortion, this treatment should only be adopted when the case is serious enough to justify such a risk; and it should therefore be preceded by a consultation.

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* Mix equal parts of hot thick water-gruel and cold milk. Add Benger's Liquor Pancreaticus ʒj., and Bicarbonate of Soda, gr. v. to ℥iv. of the mixture, with which an egg may also be beaten up. If these enemata are not retained, use solid peptone suppositories.

Abortion should be induced only when the mother's life is endangered. It is often necessary to resist the desire of the patient herself, who may be greatly wearied by the vomiting, and perhaps may prefer not to have a living child. If, however, the pulse, the tongue, and the degree of emaciation denote danger, interference should not be put off too long; otherwise it may fail to save life, and the patient may sink from exhaustion or septicæmia shortly after the abortion is completed. It is, of course, an absolute rule that, for the protection of the medical man himself, a consultation should be held before this step is decided upon. If the operation is not undertaken too late, cessation of the vomiting generally soon follows, and may be attained even before the uterus is completely emptied. The method of procedure in inducing abortion will be described in Chapter XXXI.

Other digestive disturbances.—Besides vomiting, other forms of digestive disturbance, such as pyrosis, heartburn, and flatulence, are common. Occasionally diarrhœa is set up, and this may call for treatment, especially on account of its tendency to lead to abortion or premature labour. The more common tendency is to constipation, which is partly due to the enlarged uterus mechanically interfering with intestinal movements. Laxatives will be required, especially if the patient suffers from varicose veins, or swelling of the feet, conditions which are aggravated by constipation. The pill recommended at p. 287 may be taken at night when required, or a moderate dose of the compound liquorice powder, or a small dose of saline. Sometimes enemata are found preferable to aperients. ✓

Salivation.—Salivation is a somewhat rare neurosis, but sometimes it is not only very annoying to the patient, but exhausting by its profusion. It may be combined with vomiting, and, like vomiting, it is generally most marked in the second, third, and fourth months. It is apt to resist remedies. Astringent mouth washes, tannin lozenges, and the like, may be tried; also iodide of potassium, for its influence upon gland activity, or belladonna, for its special effect on the salivary glands. Subcutaneous injections of atropia near the glands have been recommended.

Anæmia.—A certain degree of poorness of the blood in red corpuscles is the ordinary rule in pregnancy, but in some cases the degree of anæmia becomes excessive, especially when nutrition is interfered with by vomiting and other digestive disturbances. Anæmic bruits are heard in the heart and arteries, and the uterine souffle becomes unusually loud. The watery condition of the blood may lead to œdema, in the absence of any albuminuria. This œdema extends to face and upper parts of the body, but is much more marked in parts where the effect of pressure on the veins is also operative, that is to say, in the legs and vulva. In rare cases the anæmia assumes the character which has been termed "pernicious," and tends to a fatal result. A very large proportion of such cases have ended in death, even when pregnancy has been brought to a premature close spontaneously or artificially.

Treatment.—The first principle in treatment is to improve the general condition by nutritious and easily digestible diet, especially meat, when it can be taken. When practicable, the digestive powers should also be stimulated by a due amount of fresh air and gentle exercise. Iron should be given without hesitation; reduced iron, if the vegetable salts are not easily tolerated. In cases in which iron fails to do good, arsenic, manganese, or phosphorus in addition has been recommended. In rare and extreme cases, induction of abortion or premature labour may be called for. When the anæmia appears to have the progressive or pernicious character, this step should not be too long deferred.

Neuralgia.—Neuralgic pain is common in pregnancy, and may be regarded as partly a reflex neurosis, partly the result of anæmia or impaired nutrition. In the case of toothache, it often results from the fact that caries of the teeth is more liable to occur during pregnancy. Besides faceache, the most common neuralgias are headache and mammary and intercostal pain.

Treatment.—In the case of carious teeth, extraction or stopping, according to circumstances, should not be deferred on account of the pregnancy. For simple neuralgia, iron and quinine are the most valuable drugs. The latter may often be given in large doses. Opium and morphia should be avoided as far as possible. For the immediate relief of toothache or facial neuralgia, tincture of gelsemium may be given in doses of ten or fifteen minims. Outward applications, such as linimentum aconiti, are often useful.

Cough, dyspnœa, palpitation, and syncope.—Cough in pregnancy is frequently of a spasmodic and reflex character, like that which occurs in hysterical subjects. Dyspnœa and palpitation, in the absence of any cardiac affection, may be partly reflex, and partly the result of anæmia. Dyspnœa in the later months generally depends in part upon the downward movement of the diaphragm being limited, although the actual capacity of the chest is now known not to be diminished in pregnancy. Syncope in pregnancy often does not mean actual failure of the heart, but is rather of the nature of the apparent fainting which is closely allied to hysteria. There is a semi-unconscious condition, which may last for a considerable time, but no grave alteration of the pulse.

Treatment.—If drugs are required for the cough, antispasmodics, such as belladonna and bromide of potassium, should be given. For the other neuroses above mentioned, good diet and tonic treatment, especially iron, are the chief remedies. If there is dyspnœa care should be taken that the clothing is loose enough. For attacks of "fainting," alcohol should be avoided, but ether or aromatic spirit of ammonia may be given. Anti-hysterical remedies, such as valerian, may also be tried.

Eruptions.—Various eruptions appear occasionally to have a causal relation with pregnancy, as they do sometimes with disturbances of uterus and ovaries apart from pregnancy. The chief of these are acne, eczema herpes, and urticaria. A special title of "herpes gestationis" has been given to an eruption of groups of vesicles on the limbs and buttocks.* A more severe form of this, becoming pustular, and in several cases ending fatally, "impetigo herpetiformis," has been described by Hebra.† The treatment of these eruptions must be conducted on general principles.

Pruritus.—In rare cases general pruritus of the skin exists as a neurosis. Pruritus of the vulva is comparatively common. It is promoted by the local venous congestion, but most frequently has a starting point, either in some eczema of the part affected, or in the irritation of an acrid leucorrhœal discharge from cervix or vagina.

Treatment.—In pruritus of the vulva, any source of leucorrhœa should be treated, and the syringe used frequently to wash away the discharge. The bowels should be kept acting freely. As lotions to be applied directly to the affected surface, solution of borax (gr. x. ad ℥j.), the liq. plumbi subacetatis dil., solution of carbolic acid (gr. ij.—iv. ad ℥j.), and especially one of perchloride of mercury (gr. ij. ad ℥j.) may be tried. Glycerine (ʒj. ad ℥j.), and hydrochlorate of morphia (gr. ij. ad ℥j.), or dilute hydrocyanic acid (ʒss. ad ℥j.), or a combination of the two, may also be added for greater sedative effect. When the irritating effect of leucorrhœa seems to be the chief cause of trouble, the vulva may be protected with vaseline to which acetate of lead (gr. xxx. ad ℥j.) and hydrochlorate of morphia (gr. x. ad ℥j.) may be added. An ointment of quinine (gr. xxx. ad ℥j.), sometimes gives relief.

Chorea.—Chorea is not a common complication of pregnancy, but, after the age of childhood, it is relatively much commoner in conjunction with pregnancy than apart from it, so that there is no doubt that pregnancy is a strong predisposing cause. Hence the occurrence of chorea in a young woman should always raise the question whether pregnancy exists. Not only does pregnancy predispose to chorea, but the very grave or fatal cases of chorea recorded have been frequently those associated with pregnancy; and, in general, with this complication, the disease is much more likely to prove very severe as regards the violence of the motions, to lead to bodily wasting or paresis, and to be accompanied with mental disturbance, leading on, in some cases, even to mania. It is therefore to be regarded much more seriously than the ordinary chorea of children.

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* Bulkley in Amer. Journ. of Obstet., Vol. VI.

† Wien. Med. Woch., 1872. No. 48.

The immediate and essential cause of the chorea of pregnancy, as of chorea in general, is not yet fully ascertained. But it cannot be doubted that pregnancy promotes the disease in two ways, first, as a cause of reflex irritation, and secondly, by impoverishment of the blood. The element of mental emotion, well known as an occasional starting point of chorea, is also added in some cases, as when an unmarried girl has become pregnant. Those who suffer from chorea in pregnancy are generally young primiparæ, who have either suffered from the disease as children, or have an hereditary tendency to neuroses.

Prognosis.—Spiegelberg [*] gives the mortality as 23 out of 84 [†] cases; but it must be remembered that slight cases are not so likely to have been recorded as the severe. When severe, the disease has a strong tendency to produce spontaneous abortion. In many instances recovery has quickly followed, but, in a notable proportion, abortion has only occurred at an extreme stage, and death has followed shortly after. Thus, according to Barnes' statistics,[‡] out of 51 cases, spontaneous abortion occurred in 39·2 per cent., but in 9·8 per cent., or one quarter of these, death followed notwithstanding. Of two patients in whom artificial abortion was induced, one died, and one recovered. The associations with rheumatism, with a systolic cardiac bruit, and with vegetations on the cardiac valves, found in fatal cases, have been noticed in the case of the chorea of pregnancy as in that of ordinary chorea.

Treatment.—Chorea during pregnancy is less influenced than usual by drugs. The most important point is to maintain nutrition and use tonic treatment, especially iron. When movements are very violent, direct sedatives may be called for, such as bromide of potassium, chloral, opium, or morphia, and even inhalation of chloroform. When danger is indicated by great emaciation and rapid pulse, when there is notable muscular paresis, or mental disturbance so great as to threaten mania, it is justifiable to induce artificial abortion without waiting till it is too late to cure.

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[*] Lehrbuch der Geburtshülfe, 2nd ed., p. 240.

[†] Eighty of these are taken from Schwechten's dissertations, "Ueber Chorea Gravidarum." Halle, 1876.

[‡] Obstet. Trans., Vol. X.

Hysteria.—In patients subject to hysterical manifestations, these are often increased during pregnancy, and more especially at the time of labour, under the influence of pain.

The **Insanity** of pregnancy will be considered in conjunction with puerperal insanity, the latter being the more common affection.

ALBUMINURIA AND PUERPERAL CONVULSIONS, OR ECLAMPSIA.

The occurrence of albuminuria during pregnancy has been specially considered in reference to its connection with puerperal convulsions. It was first pointed out by Lever in 1842 * that, in the great majority of cases of puerperal convulsions, albumen in considerable quantity is present in the urine. The view that such convulsions are uræmic in character then generally gained acceptance. Of late, however, some observers have endeavoured to show that albuminuria in pregnant and parturient women is comparatively common, while eclampsia is very rare, and hence have depreciated the importance of the albuminuria as indicating the probable imminence of convulsions. The importance of uræmia in the causation of eclampsia has also been controverted, on the ground that convulsions sometimes occur without albuminuria, and that, in other cases, the albuminuria only appears after the convulsions, the urine before the fits, or after the first fit, being free from albumen.

Albuminuria.—The pathology of the albuminuria will be considered in the first instance, and that of the convulsions afterwards.

Causation.—Several different theories have been propounded as to the causation of the albuminuria. These are not necessarily to be regarded as rival explanations, for, while some of them seem to be inadequate taken by themselves, it is probable that, in many cases, two or more causes combine to influence the kidneys.

1. The first assigned cause is pressure upon the renal veins from the gravid uterus. This will cause some venous congestion in the kidneys, and render them more vulnerable to causes of inflammation, as a leg with varicose veins is more vulnerable to causes of ulceration. It is not a sufficient cause by itself. It is true that albuminuria may be produced by pressure of an ovarian tumour. But this does not occur till the tension is greater than is usual in pregnancy, and the albuminuria is generally a passive transudation

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* Guy's Hosp. Reports, 1842.

only, disappearing when pressure is taken off, while there is abundant evidence that, in the albuminuria of pregnancy, when notable in degree, there is generally actual nephritis. Albuminuria may also occur in the early months, before pressure on the renal veins can exist.

2. The second cause is also a mechanical one, namely, the pressure of the uterus upon the ureters. In consequence of this, the kidneys will have to secrete against a higher pressure than usual, and may find their task therefore more difficult. This cause may operate while the uterus is still mainly in the pelvis. For it is known to pathologists that, from the pressure of fibroid tumours, even of moderate size, the ureters are often found dilated ; and there is some direct evidence that this is a *vera causa*, for out of 32 fatal cases of eclampsia Löhlein found that in 8, or 25 per cent., dilatation of one or both ureters was recorded at the autopsy. An important ground for the conclusion that mechanical pressure in one or both of these modes is often an element in the case is the fact that albuminuria and eclampsia are much commoner in primiparæ, in whom the tension of the abdominal walls is greater.

3. The third cause is the increased work thrown upon the kidneys by their having to excrete the waste products from fœtus and enlarged uterus. Although the bulk of these latter is small in proportion to the body, yet activity of growth may be accompanied by active formation of waste products, and, if the kidneys are naturally weak, and barely equal to their work before, this addition may just disturb the balance, especially when added to mechanical causes of embarrassment.

4. The fourth cause is the increased arterial tension which is usual in pregnancy. This will increase any tendency which may exist to exudation or out-wandering of leucocytes into the kidney tissue. Great disturbances of the kidney circulation must also occur during labour pains. During a pain, the flow of blood through the uterus is greatly limited ; and the tension in the renal arteries, which rise from the abdominal aorta not far from the uterine arteries, is thereby abruptly raised. At the same time, a large quantity of venous blood is squeezed out of the uterus ; and thus the arterial and the venous tension in the vessels of the kidney are at the same moment elevated. It is in this way that we must explain the greater frequency with which foreign observers have discovered a slight degree of albuminuria during labour compared with that noted in the ninth month of pregnancy (see below). Such albumen, when only present in very small quantity, and without any general œdema or constitutional symptoms, is probably only a passive transudation. A similar disturbance of renal circulation, in

minor degree, must occur even during pregnancy, in consequence of the rhythmical contractions of the uterus.

5. The fifth possible cause is one suggested by Tyler Smith, namely, a reflex nervous influence starting from the pregnant uterus as a source of irritation, and disturbing the circulation or secretion of the kidneys, as those of the salivary and thyroid glands are in some cases disturbed. This it is difficult or impossible to verify, but it does not seem an improbable cause, since there is a close nervous connection between the kidneys and pelvic organs, as is often shown by the sudden copious secretion of urine in hysterical women.

6. A recent theory of the causation of the form of albuminuria associated with eclampsia is that it is dependent upon a special form of micrococcus. Cultures of this microbe have been obtained by Blanc from the kidneys, and it is stated that the product, if injected into rabbits, not only gives rise to albuminuria, but has a direct effect in inducing convulsions. There may thus be a double causation of the convulsions, the direct effect upon the nervous system of the products of the microbe, and the secondary effect produced through the lesion of the kidneys.

7. Another modern theory is that the toxæmia which produces both the nephritis and the eclampsia is the result of inflammatory processes in the placenta, a toxin resulting from which passes into the general circulation. On this ground the earliest possible induction of labour is advocated as a remedy. This theory is not inconsistent with the last, since the microbes may gain access through the placenta. Other observers, however, deny the presence either of microbes or of morbid conditions of the placenta as constant phenomena in eclampsia, and these theories have not been generally accepted.

Frequency of albuminuria.—Rather contradictory accounts have been given as to the frequency with which albuminuria exists in pregnant women, without any other morbid sign appearing. Some foreign observers make it appear to be a common occurrence. Thus Blot, Litzman, Petit, and Hypolitte have published observations in which they found albumen in the urine of more than 20 per cent. of women during or just after labour. During the ninth month, before the onset of labour, albumen was found in about 14 per cent.

On the other hand, albuminuria, which can be detected in the ordinary way by heat and nitric acid, does not seem so common in this country. Out of 200 cases in the Guy's Hospital Charity, in which the urine was tested about the time of labour, albumen was found in only four, and two of these appeared to be cases of chronic

Bright's disease. The explanation may lie in the fact, that the foreign observers used more delicate tests, and so recorded very slight traces of albumen. Such a degree of albuminuria stands widely apart from that usually associated with eclampsia, for in that albumen is generally present in large proportion.

It is of course to be borne in mind that, if albumen be found in urine passed in the ordinary way, the observation must be confirmed by testing some which has been withdrawn by catheter; otherwise the albumen may be due to some admixture of vaginal secretion. It is probable that slight traces of albumen are often due, not to any kidney affection, but to a slight catarrh of the bladder, which is not uncommon in pregnancy. In other cases, especially if occurring quite at the end of pregnancy, or during labour only, they may result from slight mechanical transudation under pressure without any nephritis.

Symptoms and course.—The nephritis associated with eclampsia, as will shortly be explained, appears in the majority of cases to be a quite recent attack. Usually only a slight amount of general œdema, which commonly has escaped notice, precedes the convulsive attack. But women who have had eclampsia in their first pregnancy sometimes have a recurrence or increase of albuminuria in successive pregnancies, and the tendency of the nephritis of pregnancy, when thus chronic or repeated, seems to be towards the production of the granular kidney of interstitial nephritis. The affection of the eyes which is common in such cases confirms this conclusion. Retinal hæmorrhages and white spots of retinitis are seen, similar to those usually associated with chronic interstitial nephritis. Pre-existing Bright's disease is generally aggravated by pregnancy. Frequently the extent of the œdema indicates that the interstitial nephritis, if any, which exists, is complicated by more or less acute tubal nephritis. The œdema is also aggravated by the tendency to hydræmia usual in pregnancy, and also by the effect of pressure. Hence it sometimes becomes very extreme in the lower limbs, vulva, and lower part of abdomen. A very marked œdema of the vulva generally means albuminuria, and not merely the effect of pressure.

The more chronic form of Bright's disease does not so frequently lead to eclampsia as the recent and usually unobserved attack. Seyfert records that out of over 70 cases in which women suffering from Bright's disease became pregnant, only two had convulsions. Hofmeier records that out of 46 cases of the more chronic form of nephritis in pregnancy, one third of the patients had convulsions.

Besides eclampsia and impairment of sight, the nephritis of pregnancy involves another danger, namely, that of paralysis. Paraplegia, hemiplegia, and facial paralysis are apt to occur in pregnancy, paraplegia being the commonest; and, in a large proportion of cases, they are associated with albuminuria. Deafness, or injury to other special nerves, may arise in the same way. As in the case of the retina, the cause may probably be either local hæmorrhages or inflammatory deposits. In most cases recovery or improvement takes place after delivery.

The milder symptoms usual in the nephritis of pregnancy are headache, sleeplessness, dizziness, and vomiting. There is an unusual proneness to the diseases of the puerperal state, such as septicæmia, cellulitis, and mania, and probably also to post-partum hæmorrhage.

In the chronic nephritis of pregnancy there is a great tendency to abortion, which appears generally the result of the prior death of the fœtus, or to premature labour with a still-born child. Thus I have known cases in which eclampsia has occurred at the first pregnancy, the albumen has disappeared or greatly diminished in the intervals of pregnancy, but a series of pregnancies have followed, each terminated by the death and subsequent expulsion of the fœtus, the albuminuria, accompanied by affection of the eyes, having recurred with each pregnancy. The only explanation possible appears to be, either that the fœtus perishes from insufficient nutrition, or that it is directly killed by a poison present in the blood. The frequent death of the child in eclampsia, where the nephritis present is usually a recent attack, is in favour of the latter explanation.

Treatment.—Very slight traces of albumen, in the absence of any symptoms, appear to be of little significance, especially if observed only in the ninth month, or during or just after actual labour. If, however, the proportion of albumen is considerable, if casts are present, or if there is general œdema or other constitutional symptoms, treatment is called for. The bowels should be kept acting freely, both with a view to keeping down arterial tension, and with the hope of carrying off some waste products by that channel. The kidneys should also be flushed as much as possible, to prevent impairment of excretory power by the choking of the tubes with epithelium. The best diuretic for this purpose is water; but salines, such as acetate of potash, may also be given. In recent and acute attacks of nephritis advantage has been found from a diet which gives the kidney as little work as possible in excreting nitrogenous material. This indication is best fulfilled by a diet consisting of milk and starchy material, such as corn-flour, sago, arrowroot, &c., alone. In chronic cases, according to the modern view, it is better not to restrict the diet too much, but to give a fair amount of meat. It seems desirable, however, to be sparing in the use of beef tea or meat extracts. Iron should be given in the more chronic cases when there is anæmia. Turkish baths may be used to stimulate the action of the skin. When albuminuria comes on first in the later months in a primipara, especially if urine is scanty, albumen copious, and there is headache or affection of vision, watch must be kept for the outbreak of convulsions. Full doses of bromide of potassium may be given as a prophylactic, and chloral may be added if premonitory signs are very marked.

If there is much œdema towards the end of pregnancy, or if the proportion of albumen is large, and increases notwithstanding treatment, premature labour may be induced. This is especially desirable in the case of a primipara, the child being viable. There is a better chance of escaping eclampsia if labour is brought on than if the kidney disease is left to become aggravated. It is justifiable even to induce abortion, after a consultation, if grave symptoms are present, especially serious damage to the retina, or paralysis.

Eclampsia.—Puerperal convulsions, or eclampsia, are to be distinguished from hysterical convulsions, and from convulsions set up by lesions of the brain on a large scale, such as cerebral hæmorrhage. The disease is also distinct from true epileptic fits, occurring casually in pregnancy, labour, or the puerperal state.

The epileptic tendency, however, appears sometimes to lead to actual eclampsia.

Clinical history and symptoms.—Sometimes the attack comes on without any premonitory signs having been observed, the patient having been about, and apparently in perfect health. More frequently there are premonitory signs, especially severe headache, lasting for at any rate some hours, and sometimes accompanied by flashes of light, or other affection of the eyes. Other premonitory signs sometimes observed are nausea and vomiting, vertigo, and dimness of sight. Sometimes not only œdema of the lower parts, but some puffiness of the face has been noticed for a few days or for a week or two. Marked œdema of the vulva is generally a sign of nephritis. The onset of the convulsions may occur either during pregnancy, generally in the eighth or ninth month, during labour, or after delivery.

The individual convulsion resembles an epileptic convulsion, except that the epileptic cry never occurs. Sometimes a definite tonic stage is observed, lasting not more than a few seconds. The face turns suddenly pale, the features are drawn and rigid, the head generally drawn to one side, the eyes turned up, showing the whites, the muscles rigid, the thumbs turned into the palms of the hands, respiration arrested. Then twitching begins at the face and eyes, and extends to more violent jerking movements of the head and neck, and of the limbs. The face becomes livid and horribly distorted, the veins distended from interference with respiration, the tongue is protruded and often bitten, the breath escapes with a hissing sound, and is accompanied with foam from the mouth. At this stage the arteries may be seen beating violently, the passage of blood through the lungs being obstructed.

In other cases no clear distinction between tonic and clonic stage can be made out, especially when the fits succeed each other in quick succession. The fits begin with twitching of the face and eyeballs, and tonic and clonic spasms of the muscles of the limbs seem to alternate. In the tonic spasms, the back may be arched, as in opisthotonos.

During the convulsions there is complete insensibility, and the pupils do not act to light. Urine and fæces may be passed. The clonic stage of convulsion may last from half a minute to two minutes, most frequently not longer than one minute.

The convulsion is followed, for a short time, by a partial degree of coma, with stertorous breathing. After a first attack, consciousness is soon recovered, but the patient is more or less confused, having no remembrance of what has occurred, and sometimes falls into a heavy sleep. The special character of the convulsions of eclampsia is that they recur. In mild cases there may be only a few fits at long intervals, and consciousness may always return in the intervals. In severe cases, the convulsions recur with increasing frequency, and in some instances more than 100 have occurred. Sometimes they follow in such quick succession as to appear almost continuous. When several convulsions have occurred at short intervals, coma, more or less complete, persists in the intervals. Breathing is stertorous, the face congested and swollen, the tongue often swollen and bleeding. The patient is generally unconscious, unable to understand when spoken to, or to answer, and remembers nothing afterwards of her condition. Reflex sensibility, however, is shown if she is touched, or when labour pains occur. During the intervals there is often a certain amount of muscular rigidity, with restlessness, more marked when a paroxysm is approaching. The sensibility of the pupils to light is diminished. They may be dilated or contracted, but generally are contracted shortly before and during a paroxysm.

Convulsions may be induced by external stimuli, especially by vaginal examinations. Frequently they are excited by a labour pain. The pain is first manifested by the groaning, restlessness, and bearing down of the patient, the uterus may be felt to harden, and then the convulsion comes on. The converse relation may also exist, and the paroxysm may induce a prolonged tetanic contraction of the uterus, lasting several minutes longer than an ordinary labour pain.* This may be one cause of the frequent death of the fœtus, by arresting or greatly diminishing the circulation through the placenta. If the eclamptic attack comes on during pregnancy, it has a strong tendency to cause expulsion of the fœtus. If the attack is sufficiently severe and prolonged, labour is sure to come on sooner or later. If the convulsions come on during labour, the pains of the second stage generally progress with vigour, and sometimes the child is rapidly expelled. This tendency may be due in part to the asphyxia produced by the convulsions, for asphyxia is well known to cause the uterus to expel its contents. Frequently the child is still-born. Among the causes tending to its death are the interference with the mother's respiration, and the prolonged tetanic contractions of the uterus, when these occur. But in some instances of mild eclampsia during pregnancy, which passed off without bringing on labour, but were associated with copious albumen in the urine, I have found that the child died at the time of the convulsions, but was expelled only after some days or weeks. This is evidence in favour of the view that, as in the case of the nephritis of pregnancy without eclampsia, a poison circulating in the mother's blood has an injurious effect upon the fœtus.

From the effect of repeated convulsions, the pulse becomes rapid and sometimes small. The rate may rise as high as from 120 to 140. From sphygmographic tracings taken during the eclamptic state, I have found that the pulse is not a dicrotic pulse of low tension, like the ordinary rapid pulse of fever, but one of abnormally high tension, like that observed in Bright's disease. The temperature also rises in a marked degree from the effect of the convulsions. In cases not actively treated, when many paroxysms occur at short intervals, it may rise to a very unusual height, such as 108° or 109°.† Any very considerable rise of temperature indicates great danger. The use of chloroform or of venesection, however, appears to interfere with the rise of temperature. If the convulsions are arrested, or occur at longer intervals, the temperature falls again, even though the coma continues. This rise of temperature is contrasted with the state of things in ordinary cases of uræmia without convulsions, for then the temperature tends to become sub-normal. A similar rise of temperature takes place when a fatal result follows, in either sex, from a series of epileptiform convulsions, much resembling eclampsia, but apart from pregnancy, and not associated with any albuminuria or nephritis. This effect on temperature appears to be evidence that the comatose state of the eclamptic patient is not simply due to congestion of the brain produced by the interference with the circulation, but indicates actual injury to the nerve-centres caused by the eclamptic explosions, an injury which is apt to lead on to a fatal result.

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* "On the Behaviour of the Uterus in Puerperal Eclampsia," by Dr. Braxton Hicks. Obstet. Trans., Vol. XXV. Spiegelberg, however, states it as his experience that the uterus is never observed to take part in the paroxysm.

† See cases recorded by Bourneville. "Etudes Cliniques et Thermométriques sur les Maladies du Système Nerveux," and by the author, Brit. Med. Journ., May 22, 1875.

Causation and pathological anatomy.—Eclampsia is not of very common occurrence. Its frequency, however, appears to vary in different countries. In the Guy's Hospital Charity it occurred once in 842 deliveries, and fatal cases amounted to one in 3,368 deliveries. In New York City, from 1867 to 1875, fatal cases amounted to one in about 700 deliveries.* The general estimate for Europe is about one case in 500 deliveries. A marked circumstance in relation to the causation is the special liability of primiparæ to the disease. In the Guy's Charity 60 per cent. of the cases were in primiparæ.

1 in 5

In by far the greatest proportion of the cases, the urine is found to be albuminous. The proportion of albumen is usually large. Frequently it occupies a third or a quarter of the bulk of the urine after settling, and sometimes the urine becomes nearly solid on heating. The urine is not only albuminous, but frequently also scanty, and sometimes almost suppressed. Often it is turbid and smoky-looking from containing blood. Sometimes the quantity of blood is sufficient to colour it red. Renal epithelium can generally be detected by the microscope, and not unfrequently casts of various kinds. It has been found by Dr. Herman that, in eclampsia, there is a marked diminution in the quantity of urea excreted. The quantity of urea increases again in patients who recover, but not in cases which end fatally. There is thus evidence of retention of products which the kidneys should secrete. It does not follow that the urea itself causes the convulsions; but it is more likely to be some substance which occurs in much smaller quantity, but is more poisonous. Thus Dührssen believes that the toxæmia is produced by creatin and creatinin, retained by the kidneys. If the patient recovers, the quantity of albumen generally rapidly lessens after delivery, and it may have entirely vanished in two or three days. Usually, however, it does not entirely disappear for some weeks. In some cases a small proportion of albumen remains for many months afterwards, but yet eventually disappears, and does not necessarily recur in future pregnancies. In other cases

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3 =

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dimin

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* Lusk, "Science and Art of Midwifery," p. 526.

the albuminuria remains permanent. In general, therefore, it may be said that the albuminuria is not a passive transudation, but an evidence of nephritis.

Some authorities have considered that the importance of albuminuria in connection with eclampsia has been overrated, and that uræmic eclampsia is only one out of several common varieties. Therefore since the albuminuria was first discovered in the Guy's Charity, it may be of interest to record that out of all cases in that charity during the forty years up to 1875 in which the urine was examined, it was free from albumen throughout in only two. In one of these the convulsions were produced by arachnitis, as verified by an autopsy; in the other they followed severe post-partum hæmorrhage, in a girl who had been seduced. The total number of cases in which the presence of albuminuria is recorded is forty-one, and there were several others in which the urine was suppressed, general œdema was present, and there was no doubt of the existence of nephritis.

The association with albuminuria is thus so general as to prove absolutely that a causal relation exists. Either, therefore, the eclampsia results from the nephritis, or the albuminuria from the eclampsia, or both are the result of a common cause.

The following explanation meets the facts of the case most fully. In the great majority of cases, the presence of a poison in the blood, due to impaired excretory power in the kidneys, or perhaps in part to the products of the same microbe which causes the nephritis (see p. 325), is an essential element in the causation. It is not, however, the sole cause, but with it are combined the increased irritability of the nerve-centres in pregnancy (see p. 117), and the presence of a cause of reflex irritation in the pregnant uterus, and often in actual labour pains. In very rare cases the reflex irritation is sufficient to cause the convulsions without any poison in the blood. That reflex irritation is a cause actually operating is proved by the fact that more than half of the cases commence during actual labour, that a paroxysm may be excited by vaginal examination or the introduction of the hand to operate, and that the convulsions frequently subside after delivery. The combination of the effect of a poison in the blood and of reflex irritation may be illustrated from physiological experiments. It is possible to give such a dose of strychnia to a frog that it remains free from convulsions, and recovers, if left perfectly quiet. By touching it, however, spasms are excited, and these, if repeated, will kill the frog. It is not, therefore, wonderful that, in pregnant women, convulsions may be the result of a recent nephritis, whereas in ordinary Bright's disease, they only occur in a late stage of uræmia.

The fact that chronic Bright's disease in pregnancy frequently does not produce convulsions may be explained by two considerations. First, the degree of albuminuria is not a measure of the impairment of the excretory power of the kidney, and in chronic nephritis a certain compensatory balance of excretory power may have been attained. Secondly, in chronic disease, the nerve-centres may become, in some measure, tolerant of the influence of altered blood. Thus when after eclampsia in a first pregnancy, albuminuria recurs in subsequent pregnancies, the eclampsia generally does not recur.

It cannot be a correct explanation that the albuminuria is the consequence of the convulsions. For, in many cases, the albuminuria certainly precedes in point of time. And, again, albuminuria is not usually the result of ordinary epileptic fits, nor even of those cases, somewhat resembling eclampsia, in which a series of epileptiform convulsions, in rapid succession, leads to a fatal result. The venous congestion resulting from the convulsions must, however, tend to increase the embarrassment of the kidneys.

Dr. Braxton Hicks* has suggested that the view which attributes eclampsia to uræmia may be erroneous on the ground that a few cases have been recorded in which the urine examined before the outset of the convulsions, or immediately after the first fit, was free from albumen, while that passed a few hours later was highly albuminous. Two of these cases are in the records of the Guy's Charity. In one, that of a patient who had suffered from epilepsy, the urine tested soon after the commencement of the convulsions was free from albumen, but next day it contained a little; and the quantity of albumen continued to increase while the patient remained under observation. In the second, a patient who had once had an epileptiform fit after an attempt at the extraction of a tooth, mild convulsions came on three days after post-partum hæmorrhage. The urine passed before the convulsions was free from albumen, but afterwards the urine became albuminous, and casts were also found. In these cases, it seems clear that there was actual nephritis. And it does not follow that impaired excretory power of the kidneys did not precede the eclampsia, because albuminuria did not precede it. A pre-albuminuric stage is recognised in chronic nephritis, and may exist also, for a few hours or days, in the more acute disease. It is significant that both patients had before shown their proclivity to epileptiform fits. They might, therefore, naturally be thrown into convulsions more quickly than other persons would, at the very first commencement of kidney derangement: and the convulsions would probably again react upon the kidney disorder.

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* Obstet. Trans., Vol. IX.

The immediate mechanism by which the convulsions are produced is uncertain. They may be caused, like the spasms produced by strychnia, by the direct action of a poison on the nerve-centres. The theory of Frerichs, that the poison is carbonate of ammonia, produced by decomposition of urea, has not been confirmed. Since convulsions sometimes occur in animals bled to death, it has been supposed by some that the immediate antecedent is anæmia of the brain, caused by spasm of the arteries. Another theory of the production of cerebral anæmia, the Traube-Rosenstein theory, has been rather widely circulated. It was suggested by Traube for ordinary uræmic convulsions, and has been adapted by Rosenstein to the case of puerperal eclampsia. The theory is, that there is excessive arterial pressure, combined with watery blood; that this produces transudation from the vessels, and thence œdema of the brain, by which the vessels are in their turn compressed, being enclosed within the skull, and so anæmia of the brain is produced, and consequent convulsions. If this theory were true, since the same cause of œdema would operate all over the body, the tendency to uræmic or puerperal convulsions ought to be proportional to the tendency to general œdema. This is not the fact, for ordinary uræmic convulsions are most frequent in the case of contracted granular kidney, when there is little or no general œdema; and general œdema is generally not very marked in puerperal eclampsia.

Pathological anatomy.—In fatal cases of eclampsia, generally only an early stage of tubal nephritis has been found, and some observers have not detected anything more than congestion. Braun, however, found evidence of nephritis in every one of seven cases in which the kidneys were examined microscopically, and, in eight other cases not examined microscopically, the appearances to the naked eye were the same. Of four fatal cases recorded by Bourneville, parenchymatous nephritis was found in one, and in the remaining three the appearance of acute tubal nephritis; namely, an opaque, swollen, yellowish-white cortical substance, and deeply congested pyramids. Angus Macdonald, arguing from the autopsies of two cases, considered the renal condition to be a degeneration rather than an inflammation, the epithelial cells in some tubes being converted into a colloid material, which plugs both these and other tubes.*

Certain cerebral conditions, such as anæmia of the brain substance, congestion of the meninges, and sometimes small extravasations of blood in the brain substance, have been described. None of these are proved to be the essential cause of the convulsions, and it is probable that the small extravasations may have been the result rather than the cause.

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* Obstet. Journ., Vol. VI., 1878.

Diagnosis.—The diagnosis from hysterical convulsions is easy. In convulsions set up by some gross cerebral lesion, such as cerebral hæmorrhage, there will generally be accompanying paralysis, such as hemiplegia, and the coma will come on more suddenly.

Prognosis. — The prognosis is grave. The mortality is now reckoned at about 30 per cent., and it was greater before the introduction of the treatment by inhalation of chloroform. About 50 per cent. of the children are lost. The danger is greater, the earlier the convulsions begin. In the Guy's Charity, the mortality was 50 per cent. in cases which began before the onset of labour, 25 per cent. in those which began during labour, and only 8 per cent. in those which began after delivery, the total mortality being 25 per cent. up to 1875. In the ten years 1875–1885, however, the mortality was only 9 per cent. Löhlein's* statistics give a mortality of 40·5 per cent. out of 83 cases which began before the onset of labour. Death most frequently results from the coma, with exhaustion; sometimes it occurs in a paroxysm. There is also a predisposition to puerperal disorders, such as septicæmia, pneumonia, and, it is said, to post-partum hæmorrhage.

Treatment.—Prophylactic treatment, for cases in which albuminuria has been discovered, has been already considered under the head of Albuminuria. When one or more convulsions have occurred, the first treatment should be to give an active purgative. This lowers arterial tension, without weakening so much as venesection, it may possibly carry off some poisonous material from the blood through the bowel, and it may sometimes remove one of the sources of reflex irritation in the shape of an accumulation in the bowels. When the patient is conscious, any hydragogue purgative, such as the Pulvis Jalapæ Co., may be used. If she is comatose, the best plan is to place two drops of croton oil at the back of the tongue.

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In former days the great remedy for convulsions was venesection; and there is no doubt that this remedy does tend to check the convulsions, at any rate, for a time. If, however, it be true that convulsions imply anæmia rather than congestion of the brain, bleeding does not seem to be a rational remedy, and there is reason to believe that, although it may check the convulsions for a time, yet the final effect is not satisfactory. It was shown by Dr. Phillips* that the general results of treatment by the administration of chloroform, without any bleeding, are more favourable. The case already referred to (see p. 333), in which convulsions, having all the characters of eclampsia, but without any albuminuria, followed severe post-partum hæmorrhage, shows that bleeding cannot be relied upon to stop convulsions, and favours the view that extreme anæmia rather promotes them. Venesection therefore should generally be reserved for a last resort in cases in which all other means fail to arrest the convulsions, or in which it is thought that extreme venous congestion of lungs would be relieved by a slight depletion.

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* Zeitschr. f. Geburtsh. u. Gynæk., B. iv. H. 2.

The administration of chloroform is the most valuable remedy of all. It has a great influence in preventing the recurrence of the fits, and it allows any necessary manipulation to be carried out without the probability of exciting a paroxysm. When the administration is commenced during the consecutive coma, this condition is generally ameliorated. The arterial tension is lowered, and the pulse at the same time becomes slower, restlessness is diminished, contraction of the pupils passes off, and usually the breathing becomes less stertorous, and the venous congestion of the face diminishes. Chloroform should always be administered when fits are recurring frequently, when they leave the patient comatose in the intervals, or when there is material elevation of temperature. At first the patient may be brought pretty fully under the influence of the drug, but afterwards it may be given only from time to time, and in partial degree. Any premonitory signs of a paroxysm, such as increased muscular restlessness, more rapid breathing, or contraction of the pupils, are indications for giving more of the chloroform, and so, *à fortiori*, is the recurrence of a fit. When chloroform is given judiciously, in this partial degree, the administration may be continued for hours together without danger. Next to chloroform, the most valuable drugs are chloral, bromide of potassium, morphia administered subcutaneously, and pilocarpine. These are most suitable for mild cases, such as those which commence after delivery usually prove to be, and for those in which it is either impossible to carry out the prolonged administration of chloroform, or it is thought unsafe to continue it longer. Thirty grains of chloral, with the same quantity of bromide of potassium, may be given either by mouth or by enema in one or two doses. Acetate of morphia may be injected in a dose of a third of a grain, and this may be repeated, if necessary. The uses of either of these drugs may be combined, if necessary, with the administration of chloroform.

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* Guy's Hosp. Reports, 1870.

In America morphia has been given subcutaneously in very large doses, from $\frac{1}{3}$ up to $\frac{9}{10}$ grains; and as much as twelve grains have been administered in four days. Veit and Olshausen in Germany advocate the same treatment. Some American authorities praise tincture of veratrum viride, given subcutaneously in doses of 10—20 minims, so as to keep the pulse-rate down to 60 per minute.

Pilocarpine may be administered subcutaneously in doses of $\frac{1}{6}$—$\frac{1}{4}$ grain. It has been suggested that it acts favourably by reducing arterial tension. This effect, however, is very much less marked than in the case of nitrite of amyl or nitro-glycerine, drugs which do not appear to produce an equally good permanent effect. It can therefore only be accepted as an empirical result that pilocarpine appears to tend to prevent the recurrence of the convulsions. This drug is recommended for all cases in which symptoms are still threatening when delivery has been completed, or when it is thought undesirable to prolong the administration of chloroform. It is dangerous, however, to give it if the patient is deeply comatose. For, if profuse salivation occurs under such circumstances, the patient may become asphyxiated by the secretion getting into the larynx and bronchi.

In the convulsions, care should be taken to prevent the tongue being bitten, as far as possible. This may be done either by placing a soft folded handkerchief between the jaws, so as to depress the tongue, or by keeping a piece of cork or indiarubber between the molar teeth.

If labour has not commenced, the great question is whether to induce labour or not. In mild cases, in which only one or two or three fits occur at wide intervals, and leave no notable coma, it may be sufficient to give purgatives, chloral, and bromide of potassium, and put the patient on a milk diet, watching carefully the proportion of albumen in the urine. But if the case is at all severe—and it is to be remembered that cases commencing before labour are much the most dangerous of all—no time should be lost in inducing labour, since nothing exercises so favourable an influence as the completion of delivery both as regards the convulsions and the condition of the urine. The first principle is to carry out no manipulation except with the aid of chloroform, for fear of setting up a paroxysm. The best mode of induction is to puncture the membranes. This at once takes off some of the reflex irritation by diminishing the tension of the uterus. In some cases I have found this suffice to stop the fits, while labour has not come on for a day or so. If the fits continue, and labour does not

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progress, the os should be dilated with hydrostatic bags, chloroform being given meanwhile.

The patient being already in labour, the general principle is to accelerate the labour, if it does not proceed rapidly, so far as this can be done without any violent interference, chloroform being always given during manipulations, even the passing of a catheter. The second stage is often rapid and tumultuous, but the first stage is apt to be protracted. If the labour progresses satisfactorily, no interference with it is needed. Otherwise hydrostatic bags may be used; after rupture of the membranes, forceps may be applied, as soon as the os is dilated enough, or, if necessary, version may be performed at rather an earlier stage. In rare cases craniotomy may be called for, especially if there is evidence that the child is dead.

After delivery, if the patient is to recover, the interval between the fits becomes longer, and the temperature falls, although coma may sometimes continue for a day or two. Chloroform may still be given, if fits recur frequently, otherwise this is the most favourable time for the action of chloral with bromide of potassium, or subcutaneous injections of pilocarpine or morphia.

A watch should be kept upon the temperature, since a considerable elevation of it is of the gravest prognosis. If it rises to a very high point, as above 104°, cold should be applied to the head, or, if necessary, to the whole body, till it is reduced. This may be effected by an ice-water cap,* or, if necessary, by cold sponging. The very high temperatures, however, are rarely observed when the fits are kept in check by chloroform, or when venesection is employed, even though the result may be fatal.

OTHER DISORDERS PRODUCED BY MECHANICAL CAUSES.

Œdema.—Œdema of the lower limbs, and sometimes of the vulva, is a common result of the pressure of the gravid uterus. The tendency to œdema is increased if there be anæmia in addition. The condition is not of much consequence, so long as it is certain that it is not due, in part, to nephritis.

Treatment.—Avoidance of standing and frequent or occasional rest in the horizontal position should be enjoined. The bowels should be kept acting regularly, to prevent an increase of pressure on the veins by a loaded rectum or a sigmoid flexure, but violent or hydragogue purgatives should be avoided, as tending to increase anæmia. If anæmia is present, iron may be given with advantage.

Varicose Veins.—Varix of the veins of the legs, thighs, and sometimes of the vulva and vagina, is also a result of pressure, especially in multiparæ, when the veins have been subject to repeated distension from the same cause. The increased volume of the blood may have some influence in the causation as well as the local pressure. Sometimes thrombosis and phlebitis occur in the distended veins, especially those of the leg. Instances are on record of fatal hæmorrhage from spontaneous rupture of a vein in the leg, or laceration by violence of a varicose vein of the vulva. If a vein is ruptured beneath the mucous membrane, *hæmatoma of the vulva* is produced. This will be considered hereafter.

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* Either Thornton's ice-water cap, made of elastic tubing, or Leiter's temperature regulator, made of metal tubing.

Treatment.—Varicose veins in general should be treated by keeping up the legs as much as possible, administration of laxatives, and the use of elastic stockings or bandages for the legs. If phlebitis occurs, the recumbent position must be maintained, and anodyne lotions applied. In the case of rupture of a vein, firm local pressure will arrest the bleeding.

Hæmorrhoids.—The passive congestion from pressure on the rectal veins, added to the active congestion which prevails throughout the pelvis, in consequence of the stimulus of the pregnant uterus, tends to the production of hæmorrhoids. The tendency is often greatly increased by the constipation which is so common in pregnancy. The fæcal accumulation compresses the hæmorrhoidal veins; violent straining further increases the venous tension, and may set up inflammation in the hæmorrhoids. A similar effect may be produced from violent straining in diarrhœa, or from the action of too strong purgatives. Internal hæmorrhoids are liable to bleed in pregnancy, sometimes to a serious extent. External hæmorrhoids, which are the commoner, often become inflamed, and cause much pain in defecation.

Treatment.—The general treatment is to give gentle laxatives, but avoid any violent purgatives. The laxatives most suitable for use in pregnancy have already been mentioned (see p. 319). Aloes, in small doses, is sometimes useful, although in large doses it is specially to be avoided, on account of its special action upon the rectum. If the piles are external, the patient should avoid using any paper after defecation, but instead of this take a vessel of water and a small sponge to the closet, and wash with the sponge. The water may be hot if the piles are inflamed, otherwise cold. For inflamed external piles, an ointment consisting of equal parts Ung. Zinci Oxidi, Ung. Plumbi Acetat., Ung. Hydrarg. Nitrat. Dilut., may be used. The distilled extract of hamamelis (Pond's extract or hazeline) may be used externally undiluted, or may be injected into the rectum, diluted with two parts of water, by means of the ordinary glycerine injection syringe, holding two drachms.

Ung Zinc Pb (acet)

Hazeline

CHAPTER XXI.

ABNORMALITIES OF THE UTERUS.

Congenital malformations of uterus and vagina.—The case of pregnancy in a rudimentary uterine horn, leading to rupture, has been already described (see p. 306). When the uterus consists of one developed half only (*uterus unicornis*), and pregnancy occurs in it, the course of pregnancy and labour is usually normal. Several varieties occur of double uterus or vagina. Both vagina and uterus may be double (see Fig. 117, p. 265), the vagina may be single and whole uterus double, the uterus may have a single cervix and double body (see Fig. 118, p. 265), or the body may be only partially divided. In all these conditions pregnancy is possible on one or both sides, and generally goes on to a normal termination. The possibility of superfœtation in a double uterus has already been considered (see p. 266). Labour may be retarded when the uterus is double, from weakness of the muscular wall, from deviation of the uterine axis, or from the other side forming an obstruction. In one case I have known the head of the child to get into the second half of a double uterus, and form a mass in the pelvis, preventing the progress of labour, and necessitating Cæsarian section, which was successfully performed. I have found the placenta retained, and very difficult to reach, at the extremity of a long diverging horn. From a similar cause, post-partum hæmorrhage may occur. When the body of the uterus is double, and one side pregnant, a decidua is formed on the unimpregnated side, and is generally expelled after delivery. This may be the only sign which calls attention to the fact of some abnormality existing. The exact character of the abnormality is best made out just after delivery, when the exterior of the uterus can be easily manipulated through the relaxed abdominal walls, and the finger can be introduced into the interior.

DISPLACEMENTS OF THE UTERUS AND VAGINA.

Anteversion and anteflexion.—In the early months of pregnancy there is usually some increase in the normal anteflexion of the uterus, and its anteversion in reference to the axis of the brim, the bladder being empty or nearly empty, in consequence of the increased weight of the fundus. Sometimes these conditions are exaggerated, especially when the uterus has been anteverted or anteflexed before impregnation. Generally the symptoms are slight, but some irritability of bladder or rectum may result from pressure of the fundus upon the former, and of the cervix upon the latter. It was considered by Dr. Graily Hewitt, that anteflexion in early pregnancy is the chief cause of vomiting, and has a strong tendency to lead to abortion, but these conclusions have not been generally accepted. It is not possible for the fundus to become incarcerated in anteflexion as it does in retroflexion, unless some other morbid condition, such as a fibroid tumour, co-exists. As the uterus enlarges, the fundus rises out of the pelvis, above the level of the pubes.

In the later months of pregnancy, anteversion, generally combined with anteflexion, appears in a different form, and leads to the condition known as pendulous belly. It is generally due to the laxity of the abdominal walls in multiparæ. The heavy fundus hangs forward over the pubes, so that the front of the fundus may be at a lower level than the centre of the uterus. In extreme cases the recti are widely separated, so that the fundus forms a kind of hernia, covered only with skin, fascia, and connective tissue. This displacement is promoted by contraction of the pelvis, sufficient to prevent the head from lying in the pelvic cavity, by any deformity which diminishes the space between the pelvis and the ribs, so that there is not room for the axis of the uterus to lie in its usual position, and by lordosis of the lumbar vertebræ, which pushes the posterior wall of the uterus forward.

When the displacement is considerable, there is difficulty in walking, dragging pain from the stretching, sometimes irritability of the bladder from the pressure upon it, sometimes œdema at the lower part of the abdominal wall. There is a tendency to abnormal presentations of the fœtus from the altered influence of gravity.

Treatment.—Little or no treatment is usually required for anteversion or anteflexion in the early months. Moderate rest in the dorsal position may be employed, and, if necessary, a hypogastric belt may be worn when the fundus has begun to rise above the pubes. Anteversion pessaries are not to be recommended in pregnancy. For the displacement in the later months, a firm abdominal belt should be worn, carrying the fundus backward and upward.

Retroflexion and retroversion.—These are by far the gravest displacements of the pregnant uterus. In the great majority of cases the version and flexion are combined. A perfectly straight retroverted gravid uterus is hardly found, except in the rare cases in which the displacement is produced suddenly by violence or strain. In some cases, however, the version and, in others, the flexion is the prominent element. Retroflexion entirely without retroversion rarely, if ever, occurs, for the cervix is almost always tilted forward more or less. Retroversion with retroflexion, in its complete form, cannot exist beyond about the end of the fourth or the middle of the fifth month of pregnancy, for, after that, the fundus is too large to be contained in the pelvis.

Causation.—This displacement arises out of a previous displacement of an unimpregnated uterus. In the great majority of cases, the displacement has become gradually aggravated in consequence of the growth of the uterus. Before pregnancy the uterus has been either retroverted, or, more frequently, in the commoner condition of retroflexion, combined with retroversion. In either case there has been more or less of that partial prolapse which is the almost invariable antecedent and accompaniment of retroversion. Pregnancy having occurred, the growing fundus begins to press upon surrounding parts. In a considerable proportion of cases of this kind the uterus eventually rights itself spontaneously, and the fundus rises out of the hollow of the sacrum into the abdomen. The mechanism by which this happens appears to depend upon the fact that the state of the pregnant uterus is, to some extent, plastic, and yields gradually to continuous pressure. Thus, being pressed upon on all sides in the pelvis, as it enlarges, it expands in the direction of least pressure, that is, toward the pelvic brim, until at length the fundus is able to get above the promontory of the sacrum.

If this spontaneous rectification does not occur, just the reverse generally happens, and the displacement becomes aggravated, the element of retroversion more especially being increased, so that the cervix is tilted more and more forward and upward, stretching the anterior vaginal wall and the urethra. This is due to the fact that the presence of the enlarged displaced fundus excites bearing-down efforts by which it is forced lower and lower, and the cervix thereby tilted forward and upward. Sometimes the fundus comes low enough actually to rest upon the perineum, and it has even been known to distend the anus. Toward the end of the third month the uterus begins to be so large that the fundus, lying from the first in the hollow of the sacrum, is detained under the sacral promontory, and is unable to rise above it, since the antero-posterior diameter of the pelvic brim is less than that of the pelvic cavity (see p. 14). In this way arises *incarceration* of the retroverted gravid uterus. Its pressure on surrounding parts grows greater; the cervix is pushed more and more forward and upward, since the fundus cannot rise, and eventually a stage is reached at which the pressure of the cervix on the neck of the bladder, generally combined with the stretching upward of the urethra, causes retention of urine (Fig. 131, p. 343).

Though this gradual mode of origin is the rule, in rare cases the displacement arises suddenly. Either a fall on the back, or a sudden muscular strain or bearing-down effort, forces the fundus down into the hollow of the sacrum. If this happens toward the end of the third, or in the fourth month of pregnancy, the fundus will be so large that it cannot easily rise again, and then the symptoms of incarceration come on suddenly or rapidly. Even this sudden mode of origin, however, implies a previous partial displacement. The fundus must have been inclined more backwards than normal, though not in the hollow of the sacrum, otherwise the abdominal pressure would have acted on its posterior, not on its anterior surface, and would only have brought it into increased anteversion. Such inclination of the fundus backward would be greater if the bladder happened to be full at the time when the sudden strain or fall took place.

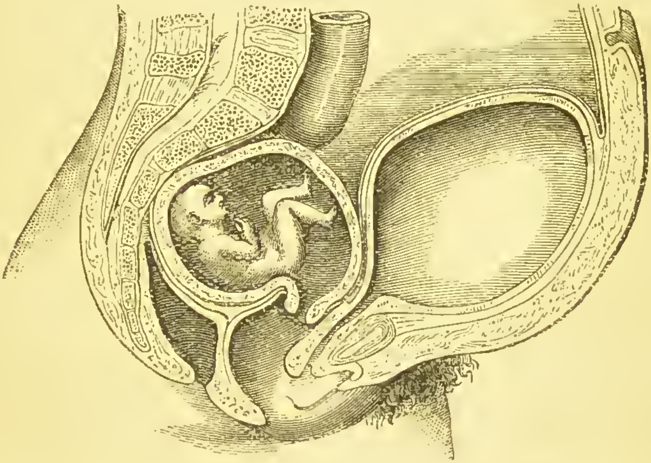

Fig. 131.—Retroflexion with retroversion of gravid uterus. Bladder distended.

Results.—Nature's readiest mode of relief is the occurrence of abortion. This may happen before the uterus is large enough to cause incarceration. Thus, if a series of abortions before the end of the third month has occurred, without any apparent cause, and an examination of the woman is made, the cause is sometimes revealed in retroflexion of the uterus, and future pregnancies proceed normally, when the displacement has been rectified. When the uterus is incarcerated, and pressure becomes severe, the tendency to abortion is increased. After abortion, the flexion of the uterus is apt to interfere with the complete evacuation of the ovum, unless the evacuation is artificially completed. From retention of a portion of ovum may arise metritis, cellulitis, or peritonitis, or possibly even septicæmia.

As soon as retention of urine is produced, grave danger arises if the case is not promptly treated. The bladder becomes greatly distended, often rising above the level of the umbilicus. Sometimes it has been mistaken for an ovarian tumour. Eventually the tension is somewhat relieved by some of the urine dribbling away. The retained urine soon decomposes, and sets up cystitis. When drawn off, it may be found bloody and intensely fœtid and ammoniacal. Sometimes the inflammation of the bladder is so severe as to cause sloughing of its mucous surface. Casts of its interior thus produced have been expelled. The pressure extends backward to the kidneys, and may set up albuminuria, nephritis, and uræmia. The septic inflammation may also extend backward to the kidneys, and lead to suppuration and the so-called "surgical kidney." Rarely the bladder ruptures, or gives way by ulceration, and rarely, also, peritonitis arises. The most frequent cause of a fatal result is the inflammation of bladder and kidneys.

Even when the stage of incarceration has been reached, a natural termination is possible, without the occurrence of abortion, provided the dangers arising from retention of urine are averted by the catheter being used whenever required. The plastic uterus gradually accommodates itself by expanding upwards in the direction of the pelvic brim, the only direction in which expansion is possible, until it has reached a sufficient size to allow the major part of the fœtus to rise out of the pelvis into the abdomen. It appears that, during this process, the fundus uteri gradually rises into the abdomen, escaping past the promontory of the sacrum by gradual growth rather than sudden movement, and that, at any rate in most such cases, the uterus thus eventually rights itself, although for some time, and perhaps even to full term, a bulging pouch, consisting of the lower portion of the posterior uterine wall, may still be felt in the pelvis behind the cervix.

R. Barnes describes an *incomplete retroflexion* as persisting in some cases to full term, the uterus being converted into two pouches, a pelvic pouch containing the head or breech, and an abdominal pouch containing the bulk of the fœtus, the cervix remaining displaced forwards and upwards above the symphysis pubis. He considers that this condition is developed out of a retroflexion in the early months by a pouch-like diverticulum being formed from the upper surface—that is, the original anterior wall—of the uterus, which eventually becomes the abdominal pouch, receiving the greater bulk of the fœtus. In most cases this condition comes under observation only when labour comes on, and its progress is arrested on account of the displaced position of the os. Depaul* contends that Barnes' explanation is incorrect, that the pelvic pouch is really formed by *saeeiform development of the posterior uterine wall*, and is not due to retroflexion in the early months. He bases his view upon the autopsy of a case in which the *posterior* uterine wall was found to be lengthened, not the *anterior*, as should be the case according to Barnes' explanation. Barnes states that he has observed the phenomena from beginning to end, but does not record any verification by autopsy.

Symptoms.—For the first month or two there may be little or no symptom, but generally there is an increase of the symptoms previously associated with the retroflexion, especially bearing-down pain in the pelvis, chiefly towards the back, and pain and difficulty in defecation; usually constipation is marked; sometimes there is leucorrhœa, sometimes irritability of bladder. Then, generally before the end of the third month, or early in the fourth month, retention of urine is produced. This generally happens the later, the greater is the amount of room in the pelvis. Often, it begins rather suddenly; perhaps in consequence of some strain or bearing-down effort. The distress then quickly becomes considerable; the symptoms of pelvic pressure are increased, but the most acute pain is due to the condition of the bladder. Reflex symptoms are excited by the presence of the displaced fundus like a foreign body pressing upon the rectum. These chiefly take the form of bearing-down efforts, by which the mischief is aggravated. Sometimes nausea and vomiting are produced. Later constitutional disturbance with pyrexia is produced by the decomposition of the urine, the inflammation of the bladder, and finally the damage to the kidneys, which may lead to uræmic symptoms. Pain indicative of peritonitis is rare, but pain from distension and inflammation of bladder, with pelvic pressure, may be severe and agonizing without the existence of any peritonitis.

When the retroversion is suddenly produced as the result of a fall or strain, the acute symptoms of pressure come on suddenly, and there may be in addition the symptoms of shock, pallor, rapid feeble pulse, sometimes nausea and vomiting.

Diagnosis.—The most characteristic symptom is that of retention of urine combined with amenorrhœa of about three months. In any case of retention of urine, where pregnancy is possible, inquiry should be made about the state of menses, and the likelihood of retroversion of the gravid uterus be borne in mind. It must of course be remembered that hæmorrhage may occur if abortion is threatened, but, if pregnancy exists, there will generally have been some amenorrhœa. Sometimes the complaint made is not of retention, but of inability to hold the urine, this condition being due to the dribbling away from the distended bladder.

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* Archives de Tocologie, 1876.

The abdomen may probably be found occupied by the distended bladder. The nature of this swelling will be cleared up by the use of the catheter. On vaginal examination, after the bladder has been emptied, the rounded swelling behind the cervix formed by the pregnant fundus will have to be distinguished from other swellings which may be found there. It will be larger than in the case of retroflexion of the unimpregnated fundus. The occurrence of amenorrhœa, changes in the breasts, and other signs of pregnancy, will help the diagnosis. Less will be felt of the fundus uteri from the hypogastrium than should be felt in correspondence with the date of pregnancy; and on bi-manual examination, the complete absence of the fundus from its normal position in front may be made out. The continuity of the swelling behind with the cervix, and the conjoint movement of the two, may also generally be ascertained.

The case of a tumour behind the uterus will generally be distinguished by the condition of the cervix. In retroflexion of the gravid uterus, there is almost always some retroversion also; the cervix is tilted more or less forward and displaced upward as well as forward, so as to put the anterior vaginal wall and urethra on a stretch. When the uterus is pushed forward by a tumour behind, the cervix is generally lower down, and looks more nearly in its normal direction. Of these two signs, the *direction* of the cervix is the more important, for the cervix may be drawn upward in the case of fibroid or ovarian tumour. In the case of tumour, the fundus may also be made out, on bi-manual examination, as lying in front. The tumours most likely to lead to error, when found behind the cervix, are small ovarian or fibroid tumours, or the sac of extra-uterine fœtation, the last being especially likely to cause a mistake. Retro-uterine hæmatocele and inflammatory swellings have also to be distinguished.

In some cases the retroflexed pregnant fundus may be detected as varying in hardness, in consequence of the rhythmical contractions of the uterus during pregnancy. The softening of the cervix will often aid in distinguishing the case from one of a tumour displacing the unimpregnated uterus. Sometimes the diagnosis can be at once completed by restoring the fundus to its place.

Treatment.—In the early stage, before incarceration has taken place or retention of urine has been produced, it is generally easy to replace the uterus. The patient should be placed in the semi-prone position. First the finger in the posterior cul-de-sac of the vagina pushes the fundus upward as far as it can reach ; next the finger is transferred to the cervix and carries the cervix well backward into the cavity of the sacrum. By this means the fundus will be brought still further forward. Either a full-sized Hodge's pessary, or an elastic ring * pessary should then be introduced. The object is to maintain or complete the restoration of the uterus rather by holding the cervix backward than by directly pushing the fundus upward. This is easier in the case of the pregnant, than in that of the unimpregnated uterus, partly because the organ is larger, and partly because it has a natural tendency to straighten itself in pregnancy, when opposing forces do not prevent this. Hence the Hodge's pessary, which in some cases acts by direct pressure upon the fundus, has not the same advantage over the ring pessary which it has in retroflexion of the unimpregnated uterus. For the first eight or ten weeks of pregnancy, a Hodge's pessary may be chosen. After that time a ring pessary acts as effectually and is sometimes more readily tolerated.

If incarceration and retention of urine have already been produced, the first thing is to empty the bladder, and the rectum also by enema, if there is any collection of fæces. After this, if the symptoms have been acute and are now relieved, and if there is no immediate threatening of abortion, it is often a good plan to keep the patient in bed for a day or two, and as much as possible in the semi-prone position, the bladder being emptied regularly, to see whether spontaneous restoration will occur. If not, the attempt should be made to restore the uterus, or this plan may even be adopted at the outset. I have hardly ever found this treatment by immediate reduction either fail to succeed, or lead to any inconvenient result. It requires, however, some dexterity in manipulation.

Great assistance is derived from the knee-elbow position. The patient is made to kneel on a flat couch so that her chest, as nearly as possible, touches the surface of the couch, and the thighs are perfectly vertical. This position makes the brim of the pelvis look almost vertically downward. When the labia are separated, air enters the vagina and distends it into a wide cavity, and the contents of the pelvis are drawn toward the abdomen, not only by their own gravity, but, in a measure, by that of the abdominal contents, which produces a negative pressure (*i.e.*, a pressure less than that of the atmosphere) in the portion of the abdomen now most elevated.

In an easy case the uterus is restored from the vagina with least discomfort to the patient. Two fingers are introduced into the posterior cul-de-sac, and placed upon the fundus as far back as possible. The fundus is then pushed toward the abdomen as far as the fingers will reach, not directly upward, but toward the side to which the fundus is already inclined in order to avoid the promontory of the sacrum. This will generally be toward the right side. Meanwhile counter-pressure may be made upon the cervix, or opposite pole of the uterus, by the other hand placed on the abdominal wall just above the pubes. As soon as the fundus has receded to the full length of the fingers, the fingers should be transferred to the cervix, and carry this fully back into the hollow of the sacrum, before the patient is allowed to lie down upon her side. If the fundus has been fully restored, it will generally remain in position ; if only partially, the displacement recurs at once, or after a short time.

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* The best form of ring pessary is that made of watch-spring covered with india-rubber, the diameter of the section of the rubber being not less than about half an inch.

Restoration by rectum.—If pressure from the vagina does not easily succeed, pressure from the rectum should be tried. This allows the fingers to reach further back and more completely to the fundus, and so affords a greater leverage. The fingers can also thus reach higher in the pelvis, especially when the vagina is not lax. One or two fingers should be passed into the rectum, the knee-elbow position being used as before, and the manipulation carried out in precisely the same way as from the vagina. Some prefer to give an anæsthetic and place the patient in the semi-prone position. With a nervous patient, this plan may be adopted ; otherwise I have found the advantage of the anæsthetic to be less than that of the knee-elbow position. But in any case, if the attempt fails, the patient should be placed under anæsthesia, and taxis again tried, either in the semi-prone or the dorsal position, whichever is found most convenient. After the replacement, the patient should be kept in bed for a day or two, and an opiate given, lest abortion should come on afterwards.

Elastic pressure.—If digital replacement fails, the method of gradual pressure should be tried. An air-ball pessary may be placed in the vagina, as far back toward the fundus as possible, and its inflation increased from time to time by means of the air-pump with which it is fitted. If this fails, pressure for some hours by an air-ball pessary or Barnes' bag in the rectum may be tried. As in the case of digital pressure, the pressure from the rectum has a greater mechanical advantage, but it is much more painful to the patient. It cannot be continued so long, and an opiate will often be required during the process.

Induction of abortion.—If all these methods fail, it is better to wait, and hope for gradual spontaneous restoration, keeping the bladder emptied, unless there are grave constitutional symptoms.

If there are, abortion should be induced. If possible, a sound or stylet should be passed through the os, so as to rupture the membranes. If this proves impossible, owing to the displacement of the os, it has been recommended to draw off the liquor amnii by puncturing from the vagina with an aspirator needle, but I have never known this to be necessary. The uterus will right itself to a considerable extent at any rate, as it expels its contents. The treatment of the partial retroflexion, real or supposed, continuing up to labour at full term will be considered hereafter (Chapter XXVII.).

The use of any pessary introduced in the early months should generally be continued up to about the end of the fourth month. After that time the fundus uteri becomes too large to descend again into the pelvis, and the pessary should therefore be removed.

Prolapse of the uterus and vagina.—Prolapse of the uterus may be real in the early months of pregnancy, or it may be apparent, being really elongation of the cervix ; or again there may be that condition which in apparent procidentia * of the unimpregnated uterus is the commonest, namely, an elongation of the supravaginal cervix combined with descent of the whole uterus. (See Fig. 132, p. 350.) Prolapse of the uterus is not very common in pregnancy, considering the frequency with which it occurs apart from pregnancy. For the prolapse is to some extent a hindrance to pregnancy, and pregnancy, when it does occur, has a tendency eventually to cure the prolapse. The uterus, as it enlarges, generally rises out of the pelvis, and eventually rests upon the brim.

Causation.—All forms of prolapse of uterus and vagina, as might be expected, occur chiefly in women who have been pregnant before. Prolapse of the pregnant uterus in the great majority of cases arises out of prolapse existing before pregnancy. In very rare instances, however, prolapse may be produced suddenly within the first two or three months of pregnancy by a fall or violent strain, just as it may in the case of the unimpregnated uterus. When a prolapsed uterus becomes pregnant, the descent may at first be increased in consequence of the increased weight. It has already been explained that descent is almost always associated with some degree of retroversion or retroflexion. The case now to be considered is that in which the descent is the main element of the displacement. If the case has been before pregnancy one of prolapse of the second degree (called also procidentia), in which the cervix descends outside the vulva, but the fundus uteri remains within the body, it will almost certainly have been associated with more or less elongation of the *supra-vaginal* cervix, the result of tension (Fig. 132). During the first two or three months of pregnancy, the cervix may still come down outside, the fundus remaining in the pelvis more or less retroverted or retroflexed. The congestion and strangulation of the cervix will then be greater than usual in consequence of the hyperæmia of pregnancy. As pregnancy goes on, the fundus almost always rises up out of the pelvis, and draws up the cervix after it. Hence in the later months of pregnancy, although the cervix may be lower than usual in consequence of its elongation, it hardly ever comes outside. Rarely the fundus becomes detained beneath the promontory of the sacrum, the retroflexion increases as pregnancy goes on, and the case becomes essentially one of retroflexion of the gravid uterus.

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* The term "procidentia" is used when the cervix descends outside the vulva.

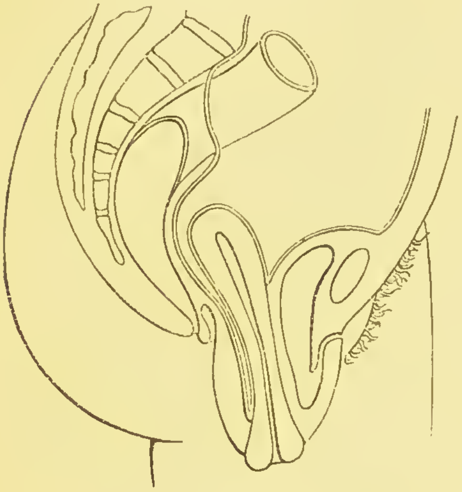

Fig. 132.—Prolapse of second degree in unimpregnated uterus.

When the prolapse is mainly apparent, and not real, the condition is generally one of hypertrophic elongation, not solely or mainly of the supra-vaginal, but of the intra-vaginal portion of the cervix. This also arises out of a similar condition existing before pregnancy. There is then usually some descent in addition, which is due to the weight of the enlarged cervix, and allows the cervix to be protruded externally. As the uterus rises out of the pelvis, any descent of the body of the uterus is remedied, and there is a tendency also to draw the cervix upward. But sometimes the cervix itself is more or less constantly gripped and retained outside the vulva, and then the traction increases the elongation of the cervix instead of remedying its malposition. Its hypertrophy also is increased, in consequence of the hyperæmia of pregnancy. Almost all cases in which the cervix uteri appears externally in the later months of pregnancy after the fifth month are to be explained in this way.

It is possible for early pregnancy to exist with *prolapse of the third degree*, in which not merely the cervix but the whole uterus is outside the body in a position of retroflexion (Fig. 133, p. 351).

The enlarging mass then soon becomes strangulated by the vulva, and abortion follows if the uterus is not reduced. Cases have been reported in which this state of things has been supposed to continue as long as the fifth or even the sixth month. But it is probable that in these cases the fundus was really in the pelvis, inside the vulva (as in Fig. 132, p. 350), although the vagina may have been completely inverted over the procident cervix.

Apparent prolapse, due to hyperplasia of the cervix, may lead to obstruction in labour in consequence of the difficulty in the dilatation of the elongated and hypertrophied cervix. This will be considered hereafter.

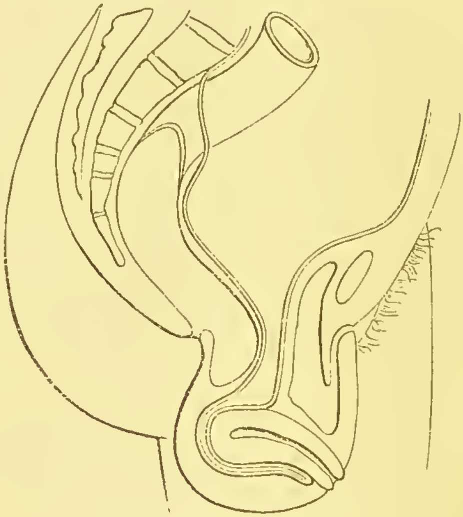

Fig. 133.—Prolapse of third degree in unimpregnated uterus.

Prolapse of the vagina alone commonly affects the anterior wall only. The posterior wall may also be prolapsed either with or without the anterior wall, generally after damage to the perineum in former deliveries. Prolapse of the anterior wall is often a sequel of an original prolapse both of uterus and anterior vaginal wall, after the uterus has been drawn up, owing to its increased size. The evolution of the vaginal walls in pregnancy tends to aggravate the condition. In labour the prolapsed vaginal wall, driven before the head, may become swollen, and form an obstacle to progress. It may even slough from the effect of prolonged pressure.

Symptoms.—The symptoms of prolapse in the unimpregnated state are generally increased in the early months of pregnancy, in consequence of the increased weight and congestion. Irritability of bladder, from the accompanying cystocele, is often troublesome. If the cervix remains external it is apt to become deeply congested, irritated, inflamed, or ulcerated from friction. This condition of the cervix may lead to abortion. A prolapsed vagina may become much swollen in labour, and form an obstacle to the advance of the head. In general, after the fourth month, as the cervix is drawn upward by the enlarging uterus, the symptoms of prolapse are considerably relieved, except in those cases of elongation of the vaginal cervix, in which the os may remain external to the vulva.

Treatment.—If there is any notable prolapse of the uterus itself within the first few months of pregnancy, it should be supported by an elestic ring, or full-sized Hodge's pessary. This may generally be removed about the end of the fourth month. In troublesome cases, and more especially if any ulceration of the exposed cervix has been produced, rest in the horizontal position is a great aid to the treatment. If a pessary is not, at first, readily tolerated on account of tenderness of the uterus or vagina, the uterus may be supported by a tampon of absorbent cotton, soaked in a solution of alum thirty grains, boric acid four grains, to an ounce of glycerine, and having a tape tied round it for withdrawal. This should be changed every day. If the cervix uteri is found external to the vulva, its reduction must be the first step in treatment. In reducing it, care should be taken not to convert the prolapse into a retroflexion by pushing up the cervix only, and leaving the fundus low down in the hollow of the sacrum. The fundus should first be pushed up from the posterior cul-de-sac of the vagina, or from the rectum. If there is any difficulty in doing this, the semi-prone, or the knee-elbow position will often facilitate it, as described for the case of retroflexion of the gravid uterus (see p. 347).

Prolapse of the anterior vaginal wall in the early months is apt to be associated with some descent of the uterus, and may then call for the use of a pessary. In the later months, it is to be treated chiefly by rest and mild astringents in the form of lotion, or dissolved in glycerine and applied by tampon, which may be kept in place, if necessary, by a perineal band. Sometimes, even at this stage, a large elastic ring pessary is of use, its anterior portion holding up the vaginal wall behind the pubes. In labour, if the prolapsed and swollen vaginal wall is driven down in advance of the head, it should be gradually drawn back over it by the fingers. In prolapse of the posterior vaginal wall, pessaries are not generally of service, and the treatment must be confined to rest and the use of astringents.

Apparent prolapse, due to elongation of the vaginal cervix, can receive benefit from a pessary only when it is associated with some actual descent of the uterus, as may be the case in the early months. In the later months all that can be done is to prescribe rest, and prevent irritation of the cervix by friction. The treatment of difficulty in parturition, arising from the hypertrophied cervix, will be considered hereafter. In all cases of prolapse, of whatever variety, attention should be paid to the regulation of the bowels, that the displacement may not be aggravated by straining.

Hernia of the uterus.—In the later months, the fundus uteri may protrude into the sac of an umbilical hernia if greatly distended or into a ventral hernia, due to stretching of the cicatrix of an abdominal section, especially one in which a pedicle of uterine or ovarian tumour has been fixed. A sort of hernia may also arise simply from separation of the recti muscles. In these cases the use of an abdominal belt during pregnancy is sufficient treatment, and birth generally takes place naturally or with the aid of forceps.

In very rare cases, the uterus has been found in the sac of an inguinal or femoral hernia, and in still rarer, pregnancy has occurred in such a uterus.* The diagnosis would be made by recognising the characters of the pregnant uterus in the sac, the absence of the uterus from its usual position, and the displacement of cervix and vagina towards the sac. Such cases have generally ended in spontaneous abortion. If the uterus cannot be returned, abortion should be induced in the early months by passing a sound or stylet through the os. Later, an operation as for strangulated hernia may possibly become necessary. If possible, the uterus should not be incised, but returned after incision of the neck of the sac, either with or without evacuation of the liquor amnii.

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* Spiegelberg, Lehrbuch der Geburtshülfe, 2nd ed., p. 262.

CHAPTER XXII.

DISEASES OF DECIDUA AND OVUM.

Decidual endometritis.—Inflammation of the decidua may arise out of previous endometritis existing before impregnation; it may be the result of syphilis, or of irritation caused by diseases of the ovum, or retention of a dead ovum. The inflammation may affect the decidua vera, serotina, and reflexa all together, or may be more especially manifested in one or two of these divisions. The study of inflammation in this situation is difficult, since even the normal rapid proliferation of cells in the decidua is analogous to the proliferation due to inflammation in other parts of the body.

The anatomical evidence of inflammation consists not only in irregular thickening, but in induration of the decidua. This is due to formation of connective or fibrous tissue, which may unite the decidua too closely with the uterine wall, and prevent the normal formation of the ampullary layer. Hence arises a difficulty of separation either of the decidua vera, or more especially of the placenta, from the uterine wall, when the full term of pregnancy has arrived, or on the occurrence of abortion. The inflammation may lead not only to hyperplasia and induration of the decidua, but to hæmorrhage into its substance, which may be the exciting cause of abortion.

Endometritis affecting the decidua serotina is of course the most important as regards its influence on the life of the ovum. This will be considered in conjunction with inflammation of the placenta. A considerable amount of change in the decidua vera is not incompatible with the continuance of pregnancy. The diseased decidua, by the irritation of its presence, may, however, excite the uterus to expel the ovum, especially when hæmorrhage has occurred in its substance.

To a special form of endometritis, affecting chiefly the decidua vera, but sometimes also the decidua reflexa, the term *endometritis decidualis tuberosa*, or *endometritis decidualis polyposa*, has been given. In this the free surface of the decidua becomes elevated in the form of bosses, or polypoid projections. These are due chiefly to local proliferation of cells and fibroid tissue, but the swelling may be increased by infiltration of blood into the tissue. Over the bosses, or polypoid projections, the orifices of the glands are generally obliterated by the cell-growths, but in the intervening parts of the decidua they remain visible.

Symptoms.—Pain referred to the uterus, or tenderness of the uterine walls during pregnancy, may arise from endometritis decidualis, but symptoms may be altogether absent.

Catarrhal decidual endometritis or *hydrorrhœa gravidarum.*—In some cases a discharge takes place during pregnancy of a thin watery or muco-purulent fluid. This may begin in the third or fourth month, but is more abundant in the latter months of pregnancy. It is attributed to hypertrophy of the glands of the decidua, and excessive secretion from them. Sometimes the discharge takes place continuously, or frequently in small quantities. In other cases, if its exit is obstructed by a plug of tenacious mucus in the os, or adhesion between the decidua vera and reflexa, it may be retained until a considerable quantity is accumulated, and then be discharged in a sudden gush. Such a flow is liable to be mistaken for the escape of the liquor amnii, or of the fluid which sometimes collects between the amnion and chorion. From both of these it is distinguished by the fact that the discharge generally takes place more than once, and from escape of the liquor amnii by the fact that pregnancy continues uninterrupted. In some cases, however, uterine action may be set up, and premature labour follow. No treatment is likely to be of any avail except the use of sedatives and rest if premature labour should appear to be threatened.

Acute endometritis or *acute metritis* in pregnancy may arise in the course of acute zymotic diseases. Apart from such a cause they are hardly ever observed unless as the result of some complication, such as the presence of a tumour, or the incarceration of a retroverted uterus; or again from a traumatic cause, such as the attempt to induce abortion.

ANOMALIES OF THE DECIDUA SEROTINA AND PLACENTA.

Anomalies of form and size.—The cord may be attached to the edge, instead of, as usual, to the centre of the placenta. This variety is called the *battledore placenta* (2. Fig. 134). The cord may reach the membranes a little distance from the edge of the placenta, the vessels dividing into branches before arriving at the placenta, and the branches running in the membranes. This constitutes the *placenta velamentosa* (3. Fig. 134). In such a case, the cord will readily tear away from the placenta, if any traction is made upon it.

In rare cases there are detached masses of placental tissue apart from the main placenta, and due to development of isolated patches of chorionic villi. These are called *placentæ succenturiatæ* (1. Fig. 134). They are of considerable practical importance, because they may easily remain behind in the uterus undetected, and give rise either to secondary post-partum hæmorrhage or to decomposition and septic absorption. The vessels supplying them may run from the edge of the main placenta, or may be separate branches in a velamentous insertion of the funis. Their torn ends would be the chief indication of a separate lobe having been left behind. Sometimes the placenta is thinner than usual, and spread over a larger surface of the decidua. Such a placenta is called *placenta membranacea.* In other cases there appears to be actually excessive development of the placenta. Sometimes this is associated with an excessively large fœtus, sometimes with hydrops amnii. Sometimes also it appears to be a kind of compensatory hypertrophy, when, for some reason, the fœtus has a difficulty in obtaining nutriment enough. The placenta sometimes appears to be unusually small, without any obvious ill effect upon the fœtus. It has already been men-

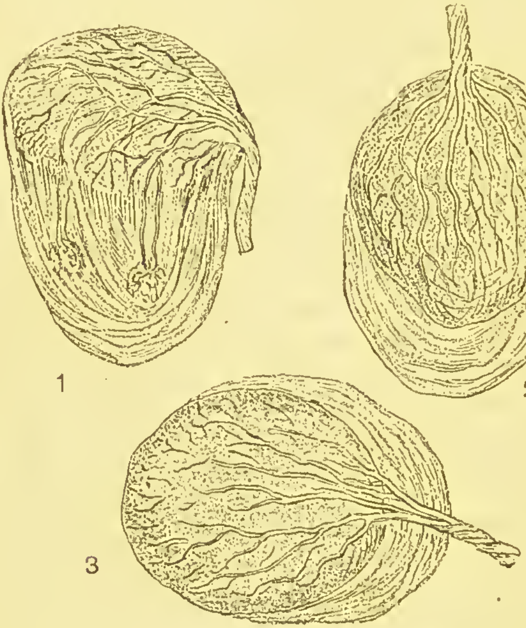

Fig. 134.—Anomalies of placenta. 1. Placentæ succenturiatæ. 2. Battledore placenta. 3. Placenta velamentosa.

(4) Placenta membranacea

tioned that in multiple pregnancy, if one or more placentæ are less favourably placed, or insufficient in extent, the corresponding fœtus is apt to perish.

Congestion of the placenta and placentitis.—Congestion of the decidua serotina and maternal portion of the placenta may arise from passive obstruction in the maternal vascular system, as, for instance, from cirrhosis of the liver, or it may be the result of inflammation. In either case it may lead to hæmorrhage, and formation of thrombus, and this may cause the death of the embryo, or excite the uterus to expel the ovum. In the fully formed placenta, permeated by the maternal blood spaces, congestion on the maternal side can exist only in the form of excessive blood pressure. This also may lead to the formation of thrombus, for if the blood escapes into any space which it does not naturally occupy, and in which the current stagnates, clotting takes place.

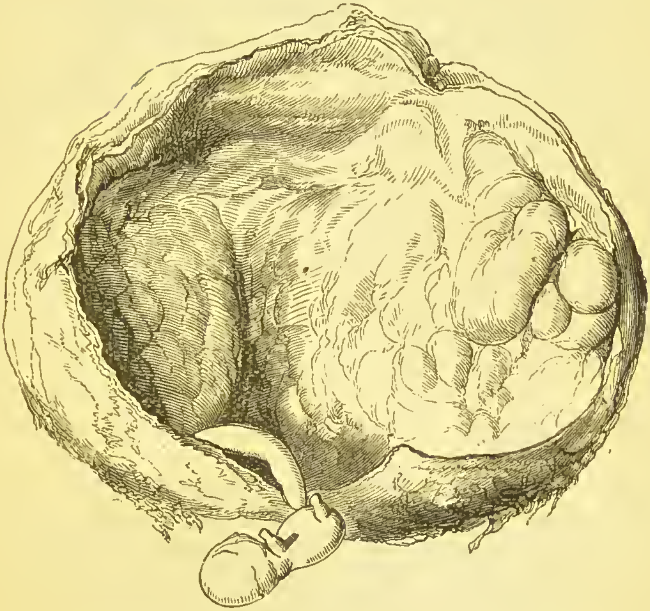

Fig. 135.—Blighted ovum with irregular thickening of membranes.

The study of inflammation in the placenta is a difficult one, and the very existence of such a thing has been denied. There can be no ground, however, for doubting that inflammation occurs in the decidua serotina and maternal portion of the placenta, as well as in the decidua vera and reflexa. The result is excessive proliferation of cells, leading to induration, the production of fibrous tissue, and often adhesion of the placenta to the uterine wall at full term, a condition which is apt to recur in successive pregnancies.

Local hæmorrhage and formation of thrombus are also apt to be produced. If this process goes on at the early stage of pregnancy, the incipient placenta becomes elevated in irregular masses, due either to cell proliferation or to associated hæmorrhage, and the embryo often perishes (see Fig. 135). It is believed that inflammation of the fœtal portion of the placenta also occurs. This appears to be manifested chiefly by excessive proliferation of the cellular substance of the villi. Frequently fatty degeneration is observed in the products of inflammation. Formation of lobular abscess in the placenta, as the result of placentitis, has been described, but is very rare. As the result of placental inflammation, on separation of the placenta at full term, a yellowish layer may be seen on the uterine surface, resembling lymph, either in patches or more diffused, often especially distributed around the edges. This consists of inflammatory products, generally in a state of fatty degeneration. In other cases localised masses of induration are found in the placenta. Sometimes again calcareous deposits are found chiefly immediately under the uterine surface of the placenta, or in the decidual processes. These appear to be due in general to degeneration in the products of inflammation, and are often associated with adhesion of the placenta. Calcareous deposit in the fœtal vessels, associated with atrophy of the villi, has also been described.

In individual cases it may be very difficult to say whether the changed character of the tissue is the sequel of inflammation or the result of degeneration. This is especially the case when the fœtal portion of the placenta is the part affected. One condition commonly found is an excessive proliferation of the chorionic villi as regards their cellular substance, associated with insufficient development of the blood-vessels in them. If, at the same time, development of the maternal blood-space is imperfect, a substance is formed firmer than normal placenta, so that continuous microscopic sections can be cut from it. This condition may be inflammatory, or closely allied to inflammation; or, on the other hand, it may be secondary to the death of the embryo, or to an insufficient supply of the maternal blood. When it occurs irregularly, forming localised indurated patches, it may be presumed that the fault originates in the fœtal tissues. In some cases it appears to be due to inherited syphilis, in others no evidence of syphilis is forthcoming.

Fatty degeneration of the placenta.—Fatty degeneration of the placenta, especially of the chorionic villi, frequently occurs when the placenta is retained for some time after the death of the

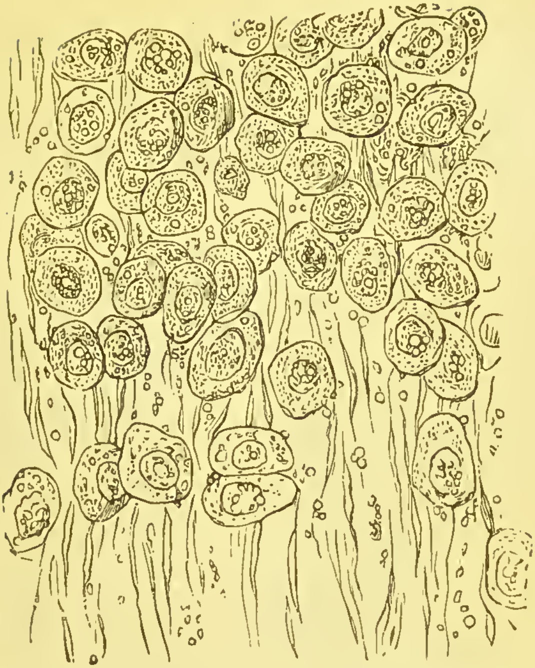

Fig. 136.—Cells of the decidua as they appear in the healthy placenta. (After R. Barnes.)

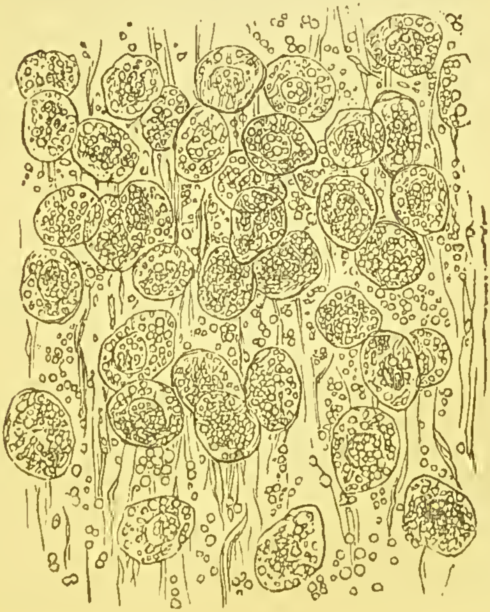

Fig. 137.—Cells of the decidua in a state of fatty degeneration. (After R. Barnes.)

embryo. Fatty degeneration also takes place in the products of inflammation. A primary form of fatty degeneration of the chorionic villi, or of the maternal portion of the placenta, distinct from either of these, is also described by R. Barnes,* who considers it the same disease as that which attacks the heart, liver, muscles, &c., of the adult. It is distinguished from other forms of fatty change by the fact that it affects the placenta irregularly, some lobules only being altered, and that, if the disease is not too widespread, the fœtus may be born alive. If extensive, it may directly kill the fœtus by cutting off the supply of blood. Short of this, it may lead to hæmorrhage on account of the friability of the diseased tissue, and the uterus may then be excited to expel its contents.

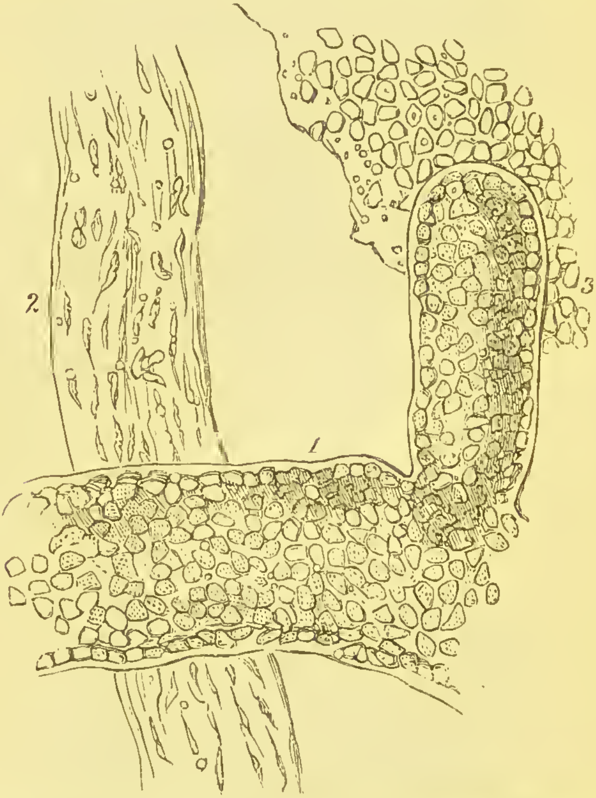

Fig. 138.—Normal chorionic villi. 1, villus with its investing epithelium; 2, villus deprived of epithelium; 3, portion of epithelium detached. (After R. Barnes.)

In fatty degeneration following death of the fœtus, the whole placenta is uniformly changed. Whatever the cause of the fatty change, the part affected appears yellowish, pale, more solid, and less spongy than normal placenta, but at the same time very friable. The individual villi are also friable, and on microscopic examination appear filled with spherical molecules. (Compare Fig. 139, with Fig. 138). A similar appearance may also be visible both in the large decidual cells, and in the fibrous stroma of the maternal portion of the placenta. (See Fig. 137, p. 359).

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* Med. Chir. Trans., 1851.

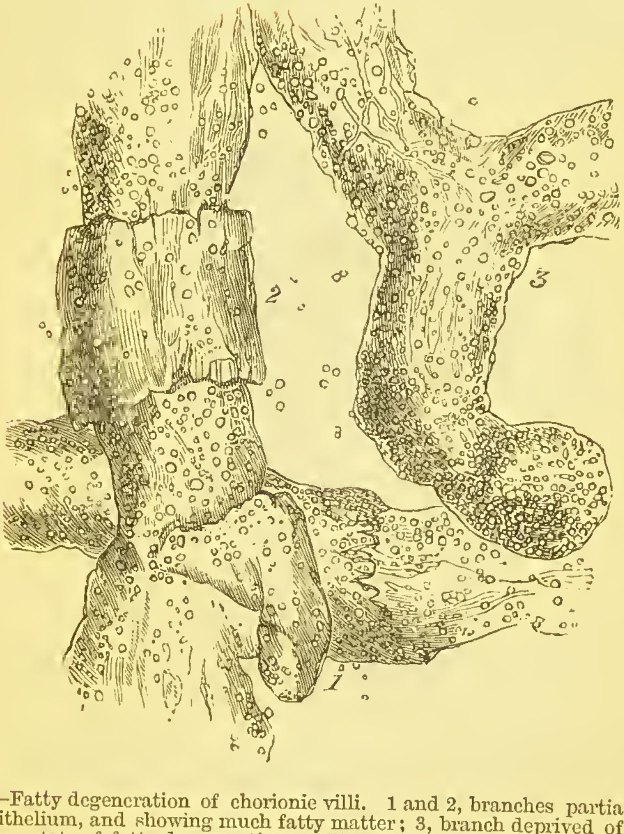

Fig. 139.—Fatty degeneration of chorionic villi. 1 and 2, branches partially deprived of epithelium, and showing much fatty matter; 3, branch deprived of epithelium and in a state of fatty degeneration. (After R. Barnes.)

Tumours of the placenta.—In rare cases tumours of the placenta have been observed of a fibrous, sarcomatous, or fibromyxomatous structure. They most frequently belong to the chorion, and are in continuity with the chorionic villi. Cysts are sometimes seen, usually on the fœtal surface of the placenta near the centre. Sometimes these are the sequel of extravasations of blood.

Hæmorrhage : Carneous mole.—Hæmorrhage into the placenta, with the formation of clots in its substance, may result either from inflammation or degeneration of the maternal or fœtal portions of the placenta. It may also arise from partial detachment of the chorion or placenta from the uterine wall as the result of uterine contractions set up by violence, emotion, or other exciting cause of abortion. This is apt to lead to the death of the embryo, which may entirely disappear if it has only advanced to a very early stage of development, or may remain of very small size in comparison to the size of the whole ovum (Fig. 140). The amnial cavity may then shrink up, or the amnion may be ruptured from the increased pressure, and the liquor amnii escape. The fœtal and maternal membranes, infiltrated with clotted blood, or having isolated masses of clot in their substance, then form a firm fleshy mass, called a *carneous* or *fleshy mole.* This may be retained in the uterus for some weeks or months, but is eventually expelled, usually not later than the fifth month. In other cases, the amnial cavity remains patent, though the main part of the mass retained in utero is formed by the thickened membranes (Fig. 140). The term "mole"

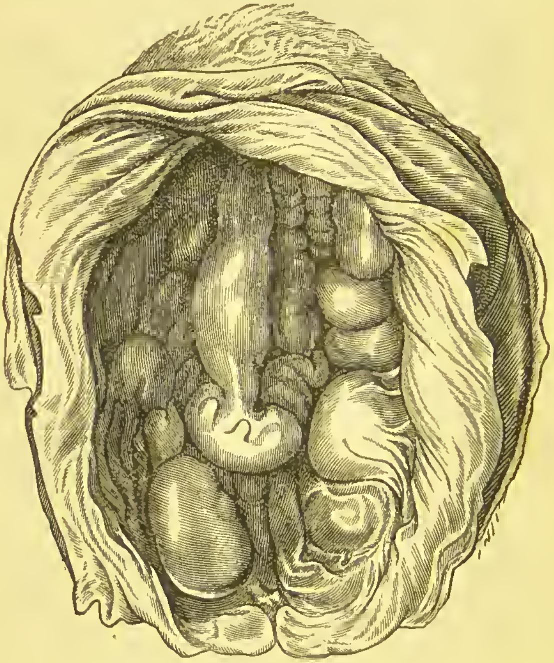

Fig. 140.—An apoplectic ovum ; blood being effused in masses under the fœtal surface of the membranes.

(from mola, a shapeless mass) is properly applicable only where there is no embryo. But it is often applied to an ovum with thickened infiltrated membranes, even though an amnial cavity and small embryo may be present, as in Fig. 140.

The situation where blood is effused may be in the substance of the chorion or decidua, or between them and the uterine wall. Frequently clot is found partly infiltrated among the villi, and partly in rounded masses which form prominences toward the amnial cavity (Fig. 140). Another frequent situation for blood to be effused, and to form clots, is the decidual cavity. It rarely breaks through into the amnial cavity.

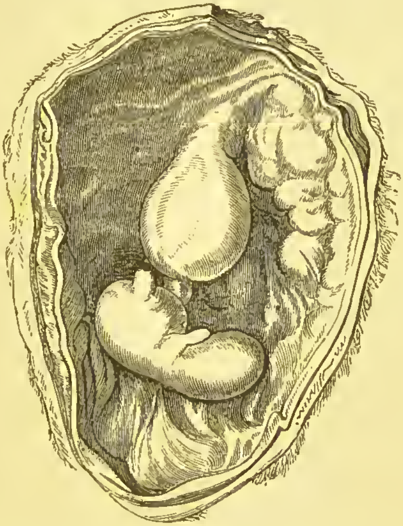

Fig. 141.—Blighted ovum, showing morbid enlargement of the umbilical cord.

The firm substance eventually expelled may have, at first sight, very little resemblance to an ordinary ovum. Not only may an early embryo have been dissolved, and the liquor amnii absorbed, but the amnion may have been ruptured, from the pressure of the extravasation, and the embryo may have escaped unobserved. The chorionic villi, retaining their attachment to the uterus, may continue to grow to some extent, so that their bulk is large in comparison with the embryo, if this can still be detected. A large portion of the mass, however, generally consists of compressed clot, which may have become decolorised. The nature of the carneous mole may always be determined by recognition of the chorionic villi on microscopic examination. They can generally be seen most easily if a small portion of the mass is spread out on a slide and examined with a low power. They may, however, also be seen in section, generally embedded in the midst of fibrin, if sections be cut of the whole mass. When a section is examined in this way it is often evident that there has been, relatively, excessive proliferation of the cellular substance of the chorion, with deficient development of its vessels.

Blighted ovum.—In other cases, again, the embryo perishes from some cause or other, whether this be some morbid condition in itself, the funis (see Fig. 141), the membranes (see Fig. 135, p. 357), or the maternal organism. The blighted ovum with relatively slight, or without any, thickening of the membranes, may then sometimes be retained in a similar way for weeks or even months before it is expelled. Generally it is expelled after two or three months at the outside; but in some cases it has been retained up to what would have been the full term of pregnancy, and then expelled. The term *missed abortion* is sometimes applied to such retention of a dead ovum, on the analogy of "missed labour," the term used when a dead fœtus is retained in the uterus after full term.

Symptoms and diagnosis of carneous mole or blighted ovum.—When the ovum has perished, the general signs of pregnancy, especially the evolution of the breasts, subside. Vomiting of pregnancy is also frequently arrested or diminished. When the liquor amnii has escaped or been absorbed, and a carneous mole has been formed, examination of the uterus bimanually may show it to be firmer than is usual in pregnancy, on account of the more solid character of its contents. It must be remembered, however, that firmness, as detected at any particular moment, may be due to contraction of the uterus, and not to solid material within it. When the embryo has been dead for some time, the size of the uterus will be less than it should be in accordance with the date of pregnancy, and the size remains stationary, instead of progressing with the advance of pregnancy. This is the most reliable sign of all; and, in case of doubt whether the ovum is still alive, it is desirable, when symptoms are not too serious, to wait until time enough has elapsed for it to be manifested. It should not be forgotten that pregnancy sometimes commences in a period of amenorrhœa, and that, on this account, the pregnancy may be supposed to be further advanced than it really is. During the retention of the carneous mole, or blighted ovum, there is no proper menstruation. Either amenorrhœa may persist, or there may be a continuous or irregular sanguineous discharge. Sometimes the colour of the discharge, instead of being that of bright blood, is brownish, from the breaking up of clot.

Treatment.—In some cases the retention of a dead ovum appears not to affect the health perceptibly. The case may then be left to nature, in the expectation that the contents of the uterus will be expelled within a few weeks, and delay is especially indicated, if there be any doubt about the diagnosis. If there is a general appearance of cachexia, or other sign that the health is suffering, if there is hæmorrhage or offensive discharge, or if the retention is long protracted, the uterus should be emptied. A few full doses of ergot may first be tried, and the sound may be passed into the uterus. If these means do not bring about expulsion, the os may be dilated with a laminaria tent. This may be followed up, if necessary, by dilatation with Hegar's dilators, under anæsthesia, and digital evacuation of the uterus as described in Chapter XXIV.

Œdema of the placenta.—In some cases the placenta is found unusually large, heavy, pale in appearance; and the fluid which oozes from it is not pure blood, but semi-serous in character. The placenta still remains unusually large and heavy, even after draining. There has thus been actual hypertrophy of the villi, in compensation for the impairment of their function.

It appears that œdema of the placenta may arise from a fault either on the maternal or the fœtal side. Thus it has been observed in conjunction with general œdema from albuminuria, or with ascites arising from hepatic obstruction on the mother's part. In other cases, it is associated with hydramnios or œdema of the fœtus, and then appears to be dependent on some anomaly causing obstruction in the fœtal circulation. It appears that the serous effusion may be either in the villi, or in the decidual processes, or in both. The blood circulating in the maternal blood spaces may also be too watery, if the cause of the affection is albuminuria or anæmia on the mother's side. Œdema of the placenta is apt to lead to imperfect development or death of the fœtus, and to premature labour.

Hydatidiform degeneration of the chorion. Vesicular or hydatidiform mole.—In this disease the villi of the chorion undergo proliferation with myxomatous degeneration, so that portions of them become converted into cysts filled with a fluid containing mucin as well as albumen. The vesicles may be of any size up to about half an inch, or even more. The general appearance produced is shown in Fig. 142. It has been compared to that of a bunch of grapes, but the mode of attachment of the cysts is essentially different. Instead of being attached by stalks to branches of a main stem, each cyst is attached by a pedicle to another cyst, that again to another, and the final pedicle not to a main stem, but to the convex surface of a membrane, the chorion. The formation of the individual vesicles is due to the fact that the proliferation of cells with degeneration does not affect the villi uniformly throughout, but takes place at detached centres (Fig. 143). The altered portion of the villus grows into the vesicle; the intervening parts which remain normal, or comparatively normal, form the connecting pedicles. The hydatidiform vesicles were formerly confounded with true hydatids, but are easily distinguished from them by the fact of their being pedunculated. True hydatids may occur in the uterus as elsewhere, but very few instances are recorded of their having been found in that situation in Britain.

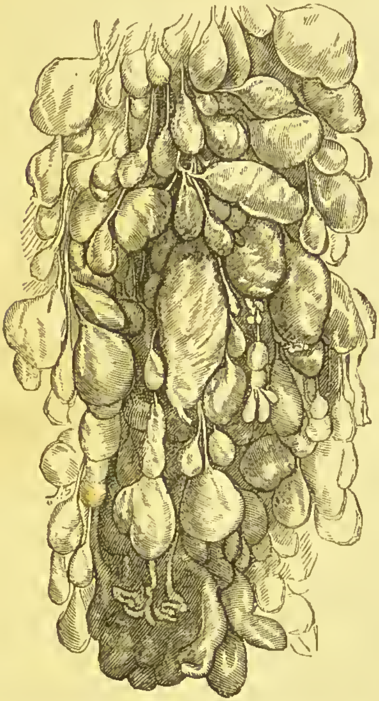

Fig. 142.—Hydatidiform degeneration of chorion.

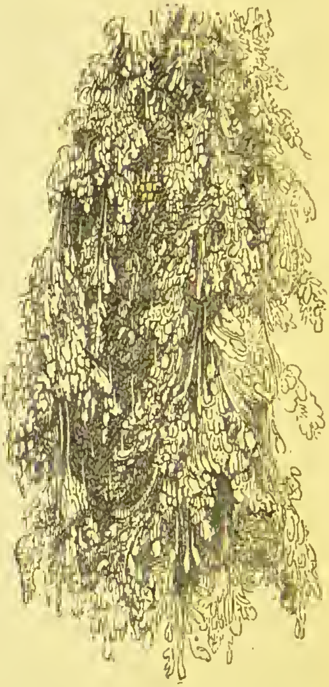

Fig. 143.—Commencement of hydatidiform degeneration of chorion.

In the majority of cases, the degeneration commences within the first two months of pregnancy, before the placenta is fully differentiated, and it then usually affects the whole of the convex surface of the chorion. The embryo may have disappeared altogether, or may be found in a blighted condition, if it has reached a somewhat later stage of development. When the hydatidiform change commences after the formation of the placenta, it generally affects only the placental site. In the great majority of cases, the fœtus perishes before or after the formation of the mole has begun, but, in some instances, in which only a few lobes of the placenta have become degenerated, or in which the degeneration, though more widely spread, is only partial, a healthy fœtus has been found in combination with a vesicular mole. More frequent than this is the association of a twin fœtus with a vesicular mole. In some cases the tendency to active proliferation of the diseased villi is shown by their invading the uterine wall. They appear to reach the uterine sinuses by dipping into them from the maternal blood spaces, as the normal villi sometimes do. But they sometimes penetrate much more deeply into the uterine wall than normal villi ever do, and may reach quite close to the peritoneal surface. In some cases the uterine wall becomes broken down, in consequence of the pressure produced by their proliferation, and replaced by the diseased mass. If this process reaches near to the outer surface, peritonitis may be set up, or even rupture of the uterus may occur. A vesicular mole sometimes grows to so great a size as to enlarge the uterus as much as pregnancy at full term. More frequently the uterus is not enlarged beyond its size at the fifth or sixth month of pregnancy.

Causation.—The causation of the degeneration is not fully understood. The formation of the vesicular mole has sometimes been repeated in the same woman, and hence it is inferred that the condition of the mother may have something to do with it. Thus inflammation or fatty degeneration of the decidua may be predisposing causes, and these conditions have actually been found in conjunction with the vesicular mole. Again, Bright's disease or syphilis in the mother has appeared, in some instances, to be the predisposing cause. The fact that the disease is much commoner in multiparæ than in primiparæ appears to indicate that some morbid state of the uterus promotes its occurrence. Probably the more important part of the cause lies in a fault of development in the fœtal portion of the ovum. This is the readiest way of explaining those cases in which there are twin ova, of which one is developed normally, while the other undergoes vesicular degeneration.

As it arises from the chorionic villi, the vesicular mole is necessarily in all cases the product of conception, although some have occasionally maintained the chastity of a woman who has been delivered of one. It does not however necessarily imply a recent conception, for the diseased structure may be retained for some time within the uterus, and afterwards grow to a considerable size. There are some cases of myxoma of the uterine wall, in which there is a proliferation of myxomatous villi into the uterine cavity, which may be mistaken, even by skilled observers, for a vesicular mole. If however the basement membrane, the chorion, from which the villi grow, is discovered, the diagnosis of vesicular mole is absolute.

In some cases a fœtus has been born at full term, and a hydatidiform mole has been expelled some months later, when no second conception has been thought possible. This may be explained either on the ground that there was a twin ovum which had undergone degeneration, or that a portion only of the villi of the first ovum had undergone this change, and had been retained in consequence of the close connection which they form with the uterine wall. In other cases again, a hydatidiform mole has been expelled first, and a living fœtus some months after. These again may have been instances of twin pregnancy. It does not appear that a piece of normal placenta retained in the uterus at the expulsion of the fœtus can afterwards undergo the vesicular degeneration. Some have maintained the theory that the origin of the vesicular degeneration is the previous death of the fœtus. This seems to be disproved by the cases, which are fairly numerous, in which a living fœtus has been associated with partial vesicular change. When the degeneration of the placenta is general the fœtus must inevitably perish as a secondary result.

Symptoms and course.—At first the symptoms may not differ from those of ordinary pregnancy. After two or three months the enlargement of the uterus and of the abdomen is often more rapid than in normal pregnancy, but this is not invariably the case. When it is so, constitutional disturbance may be set up by the unusual tension, and uterine contractions, threatening abortion, may be excited. Frequently the first thing which attracts attention is a sanguineous discharge. This may consist either of pure blood, or of a more watery fluid, compared to red-currant juice, due to the rupture of some of the vesicles. Sometimes clusters of vesicles come away with the discharge, and the comparison is then to white currants floating in red-currant juice. The hæmorrhage may greatly exhaust the patient, or even lead to a fatal result. Eventually the uterus may either expel the great mass of the mole, leaving other more adherent portions behind, or it may completely empty itself. In the former case hæmorrhage continues or recurs; in the latter, involution of the uterus takes place as after abortion or delivery.

Diagnosis.—An absolutely certain diagnosis can only be made when some of the vesicles are discovered. A probable diagnosis may be based upon the following points—the size of the uterus not agreeing with the duration of pregnancy, especially a too rapid increase of size; presence of sanguineous or "currant-juice" discharge; and absence of any tangible parts of the fœtus, of any ballottement, or signs of fœtal life, when the uterus has reached a size at which these ought to be discoverable in normal pregnancy.

Prognosis.—The result is generally favourable, if adequate treatment is undertaken early enough. The danger chiefly depends upon the amount of blood lost. There is a risk also of septicæmia and other post-partum disturbances, to which the loss of blood renders the patient more liable. The rarer cases, in which the growth deeply penetrates the uterine wall in a quasi-malignant manner, are always dangerous, since they involve the risk of peritonitis or rupture of the uterus.

Malignant disease, analogous to the deciduoma malignum which may follow normal delivery (see Chapter XL.), has been observed after vesicular moles in a very much larger proportion of cases than after normal pregnancy. Thus, Marchand collected twelve cases occurring after vesicular mole, which is a very rare disease, as compared with fifteen cases after full term delivery. This is accounted for by the fact that, in vesicular mole, there are often extensive tracts of *syncytium* or nucleated protoplasm, sometimes divided into individual cells, and resulting from proliferation of the fœtal epiblast.

Treatment.—When a positive diagnosis has been made by inspection of some of the vesicles the uterus should be evacuated as soon as possible. The only exception to this rule is the rare case in which the presence of a living fœtus is detected in addition to the mole. If the hæmorrhage is not serious the physician may then defer interference in the hope of saving the fœtus. If the diagnosis is only probable, the decision in favour of evacuating the uterus or otherwise must depend upon the amount of hæmorrhage, and its effect upon the patient's condition. It is to be remembered that the vesicular mole is a very much rarer condition than ordinary pregnancy with hæmorrhage, due to threatened abortion.

If the os is dilated, and the expulsion of the mole has commenced, the evacuation of the uterus may be assisted by manipulation. If not, supposing that evacuation is resolved upon, the cervix must be dilated first by a tent if necessary, and afterwards by Hegar's dilators (see Chapter XXIV.), or by hydrostatic dilators, if the uterus is very large, until it will admit two or three fingers. The patient should be placed under an anæsthetic for the evacuation. A full dose of ergot may be administered a little before, or ergotin may be injected subcutaneously at the time of operating in order to gain the assistance of the uterus in expelling the mass and diminish hæmorrhage.

The patient is placed in the dorsal position for the operation, and according to circumstances, either the whole hand or the half hand, not including the thumb, is passed into the vagina. The bladder is to be emptied previously, and the other hand, placed upon the abdomen, presses down the fundus upon the fingers in the vagina. In general it is sufficient to pass two fingers into the uterus to scoop out the vesicular mass. After the lower part is removed, the contracting fundus, aided by the external pressure, brings more and more within reach of the fingers, until the interior of the fundus is reached and the whole cavity evacuated. If however the uterus is very greatly enlarged and the cervix wide, four fingers or the whole hand may be passed into its cavity. In other cases again, in which the vagina is narrow, the evacuation may be effected without more than two fingers being passed into the vagina, the uterus, toward the end of the process, being pushed down close to the outlet in a position somewhat of anteversion. I have known the lower part of the uterus to be filled with a mass of clot; so that it was only after the evacuation of a large part of this that the vesicular mole could be reached, and the diagnosis positively completed.

If the vesicles are not easily detached from the uterine wall, care must be taken not to use too much force in detaching them. Otherwise, in a case in which the growth has invaded and eroded the uterine wall, a rupture reaching the peritoneal surface might be produced. The operator should carry the separation only so far as he can effect it with the pulp of the fingers, not using the nails. If vesicles are left embedded in the uterine wall, they will probably be destroyed by pressure, if the cavity is once thoroughly evacuated, and a firm contraction secured. After the operation, a course of ergot should be given to assist involution. If it has not proved possible thoroughly to clear the cavity, or if an offensive discharge from it appears, the uterus should be periodically washed out with an antiseptic solution.* If hæmorrhage persists, the cavity of the uterus should be again explored after an interval.

Hydramnios or Hydrops Amnii.—The quantity of liquor amnii varies considerably in different cases. When it is so much in excess as to cause constitutional disturbance to the patient, the condition is called Hydramnios.

Causation.—In some cases, hydramnios has been observed in conjunction with certain morbid conditions in the mother, such as albuminuria, syphilis, or diabetes, which appear to have something to do with the causation. In general, however, the fault is rather on the fœtal side. This is shown by the fact that hydramnios is specially frequent in twin pregnancy, but, as a rule, only one of the ova is affected in this way. Again, in a large proportion of cases (about 75 per cent. according to McClintock), the fœtus has been found to be of the female sex. The fœtus is rarely quite perfectly developed or well nourished, and in a considerable proportion of cases, is born dead or dies soon after delivery. This may be due in part to the premature delivery which is common in such cases. A considerable number, however, of the fœtuses (15 per cent. according to McClintock) are dead and macerated before delivery. The placenta is often found in some way anomalous, either unusually large or œdematous. It may be concluded that the cause of the condition must be attributed in most cases to some obstruction in, or abnormal distribution of, the fœtal circulation, especially the circulation in the placenta.

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* Solution of perchloride of mercury (1 in 4000); Tinct. Iodi. ʒij. ad aq. Oj.: or Acid. sulphuros. ʒiv. ad aq. Oj., may be used.

Symptoms and course.—The symptoms are the effect of the mechanical pressure due to the rapid increase in size of the uterus. This increase generally does not first become manifest before the fifth month, but it may go on so rapidly that the uterus is soon much larger than it usually is at the full term of pregnancy. The symptoms are then similar to those produced by a large ovarian tumour. There is pain from tension and the weight of the abdominal contents, dyspnœa and palpitation from interference with the diaphragm, and disturbed digestion, also from the effect of pressure. The urine is often scanty, and when tension is very great, it may become albuminous. There is often œdema of feet and legs, and this may extend to the vulva and lower part of abdomen. Often spontaneous relief is afforded by the occurrence of premature labour. The first stage of labour is apt to be tedious from the over-distension of the uterus. From the same cause, there is a greater proneness than usual to post-partum hæmorrhage, as there is in the case of twins.

Diagnosis.—There may be difficulty in diagnosis when the collection of fluid is very great, and the fœtus small or dead, so that the fœtal heart and movements cannot be detected. I have met with several cases in which the uterus had been tapped in the belief that it was an ovarian cyst, not always with the result of bringing on labour. The softened state of cervix and expansion of lower segment of uterus, as felt per vaginam, combined with a history of amenorrhœa, will generally prove pregnancy. Frequently also, although the distended uterus may give a fluid wave or thrill as distinct as that to be detected in an ovarian cyst, the firm body of the fœtus may be felt on dipping for it with the fingers in the midst of the fluid mass. The difficulty which sometimes arises is that of distinguishing between hydramnios and an ovarian cyst complicating pregnancy. For although the body of the pregnant uterus may generally be made out as separate from the ovarian cyst, this may not be possible if distension is extreme. The most valuable distinction of all is to be found in the fact that, notwithstanding the over-distension of the uterus, the occasional contractions, previously mentioned as a sign of pregnancy (see page 123) may still generally be detected in it, especially if excited by manipulation. A hardening of the wall of the tumour is thus produced, and if it can be made certain that the hardening extends to the *whole* tumour, it is proved that the whole of it is uterus. Another useful distinction may often be found in the fact that, when the uterus is so distended as to simulate a large ovarian cyst, there is generally some yielding of the cervix, more than exists normally at the fifth or sixth month of pregnancy, so that the finger may be pressed into it far enough to reach the membranes.

In minor cases of hydramnios, the distinction has to be made from twin pregnancy. This may be done by obtaining the positive signs of the existence of twins (see p. 262), in the one case, or by noting the altered consistency of the uterus from the excess of fluid within it in the other.

Treatment.—In mild cases, all that can be done is to prescribe rest, and the support of the uterus by an abdominal belt. If serious constitutional disturbance is caused, labour must be induced. It is desirable, if possible, to wait until the child is viable. Sometimes, however, it is necessary to interfere before this, and there need be less reluctance to do so from the fact that, in such a case, there is little chance of a healthy child surviving.

If there is a hope of saving the child, the induction of labour may be commenced by passing an elastic bougie into the uterus in the mode hereafter to be described (see Chapter XXXI.), or by dilating the cervix. If not, there is no object in keeping the membranes intact. The membranes may then be ruptured by passing a sound or stylet, or instrument specially designed for the purpose, through the cervix. In the first stage of labour, when it comes on spontaneously, it will often be necessary to stimulate the over-distended uterus to contraction by rupturing the membranes early and evacuating the liquor amnii, if this has not already been done. After delivery, a dose of ergot should be given, and special care taken to guard against post-partum hæmorrhage.

Deficiency of liquor amnii.—Deficiency of liquor amnii in the later months may lead to protraction of the first stage of labour, the fluid being insufficient to form a properly bulging bag of membranes. In the early stage of pregnancy, if there is any inflammatory condition in addition to the scanty amount of fluid, adhesions may form between the amnion and the skin of the fœtus. As more liquor amnii is secreted, these adhesions may be stretched out into bands. In some cases the traction or pressure of such bands has caused fœtal deformities or intra-uterine amputation of limbs.

ANOMALIES OF THE FUNIS.

Knots.—A knot in the funis is produced by the fœtus passing through a loop in it. This may occur either during pregnancy or only in labour. It is favoured by the funis being unusually long, so that a loop is readily formed towards the lower part of the uterus. Complex knots may be produced if the fœtus passes twice or more through the loop. In general, the knot is not drawn so tight as to obstruct the circulation, and it has then little practical effect. If the knot is formed only in labour, generally no mark remains upon the funis when it is undone. If it is of longer standing, the gelatinous substance of the cord is found to have disappeared at the points exposed to pressure. In rare cases, the knot becomes drawn so tight that the fœtus perishes, generally in the earlier months of pregnancy.

Coils.—The funis may be coiled once, twice, or oftener, round the neck of the fœtus, and it may be also coiled round the limbs. A coil round the neck may be regarded as the first stage toward the formation of a knot in the cord, the head only, and not the whole fœtus, having passed through the loop. Coils, like knots, are most likely to be formed when the funis is longer than usual. Coils round the neck generally come into any practical operation only during labour. They then shorten the length of funis available, and so may cause obstruction to labour, or detachment of the placenta. These difficulties in labour will be considered hereafter (see Chapter XXVIII.). They may also cause death of the fœtus by strangulation, when put on the stretch with the advance of labour. In rare cases, a coil or coils round the neck become so tight in the course of pregnancy as to destroy the fœtus. Sometimes even the head is nearly amputated by the constriction. It is believed that intra-uterine amputation of limbs also may sometimes be produced by constriction through a coil of funis, but it is probably due much more frequently to a band resulting from amnial adhesion.

Torsion.—It has already been explained that the vessels of the funis, originally straight, become gradually twisted as pregnancy advances, from the rotations of the fœtus in one direction preponderating over those in the other direction. The same cause acting in a more sudden or rapid manner, may cause actual torsion of the whole funis to such an extent that the calibre of the vessels is more or less obstructed. The torsion is generally most marked near the umbilicus, Wharton's jelly being thinner at that part, and the resistance of the funis being, therefore, less. The torsion may be produced either after the death of the fœtus or during its life. In the former case, it must be due solely to rotations produced by movements of the mother and external pressures. It will take place more readily from the fact that the firmness of the funis, and its consequent resistance to torsion, is diminished by death. Torsion of the funis during the life of the fœtus may be due both to fœtal movements, and to maternal movements and pressures, probably for the most part to the former. By causing obstruction of the vessels, it may lead to the death of the fœtus. In individual cases, it may be difficult to determine whether the torsion is the consequence or the cause of the death of the fœtus. But in a considerable proportion of the cases there is evidence that it occurred after the death of the fœtus, first because the degree of torsion is much greater than would be sufficient to kill the fœtus, and secondly, because other sufficient cause of its death, such as the presence of syphilis, is discovered.

ANOMALIES AND DISEASES OF THE FŒTUS.

The fœtus is subject to innumerable faults of development, and to a considerable number of diseases. For these, the reader is referred to works on malformations, and on diseases of children.* Space will allow here only a brief reference to a very few conditions which have a special obstetric interest.

Intra-uterine amputation of limbs.—Limbs occasionally present the appearance of having been amputated, the stump having healed over. In individual cases there may be a doubt whether the condition is really due to amputation or to failure of development. But, in some at any rate, the amputation is positively proved, for not only is the cause of amputation evident, generally in the form of some amnial band, but the amputated limb itself is found loose in the amnial cavity. Sometimes rudiments of fingers or toes are seen at the extremity of the stump, and it has been supposed that these indicate an effort of nature to reproduce the amputated part, similar to that which occurs in some of the lower animals. It is probable, however, that such cases are really due to arrested development, and are not the result of amputation.

Deficient closure of abdominal walls or exomphalos.—In the early stage of fœtal existence a portion of the intestine normally projects outside the abdomen at the umbilicus. Sometimes there is a failure in the natural process by which this portion of intestine is drawn into the abdominal cavity and the abdominal walls are closed in. A kind of hernial sac then exists at the time of birth, generally covered only by amnion and peritoneum. The size of the sac varies greatly; sometimes it contains only some coils of intestine, frequently a part of the liver also. Sometimes nearly the whole of the abdominal contents, including the stomach, spleen, and even kidneys, are outside the abdomen. The funis is generally attached towards the summit, or near the lower part, of the protuberant mass, and the vessels divide and spread out over the peritoneum. Sometimes the funis is abnormally short or even absent. The condition is often combined with other malformations in other parts.

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* See Förster, "Misbildungen der Menschen," 1861; Ahlfeld, "Die Misbildungen der Menschen, mit Atlas," 1880; Noble Smith, "The Surgery of Deformities."

When the extruded mass of viscera is large, it may form the presenting part, the fœtus lying in a position of opisthotonos, and it may then give rise to some difficulty in diagnosis. The child will generally be incapable of surviving.

Spina bifida, meningocele, encephalocele, and tumours.—These conditions will be described in Chapter XXVIII., under the head of obstructions to labour.

Intra-uterine fracture of bones.—Apart from the fracture of bones which may arise in difficult labour, whether completed naturally or artificially, cases of intra-uterine fracture have also been observed. The limbs, as being the parts most exposed, are chiefly affected, and more especially the thighs. Considerable violence to the mother may fracture the bones even of a healthy fœtus. More frequently the fractures occur when there is unusual fragility of the bones from imperfect development, especially from a deficiency in the inorganic constituents of the bone. This is usually the result of intra-uterine rachitis. In such cases fractures occur from very slight external forces, and in some instances children have been born with a large number of fractures, amounting to forty or more. Some of the fractures may be found united, or partially united, at birth. Frequently, besides the fragility of the bones, some other sign of imperfect development exists, such as deficient formation of the bones of the cranium. Dislocation is apt to be added to the fractures, from the effect of the traction of muscles acting upon the separated fragments. In other cases, separation of the bones results, not from actual fracture, but from failure of union between different centres of ossification or separation of epiphyses, sometimes the result of inflammation. This may result from syphilis, as well as from rachitis.

Congenital dislocations, so-called, affect most frequently the hip-joint, and, next to that, the shoulder. In most cases, at any rate, the condition is really due to a fault of development rather than to dislocation, the articular cavities being formed in an abnormal position.

Tightness of frenum linguæ.—In some cases the frenum linguæ extends too forward toward the tip of the tongue, so as to prevent the tongue being extruded, and the child is then said to be tongue-tied. This condition may make it impossible to suck; and, if not relieved, may afterwards interfere with articulation.

Treatment.—The thin part of the frenum should be snipped through with blunt-pointed scissors, care being taken not to endanger the lingual artery. better tear thro' c̄ clean finger nail

Syphilis.—Syphilis in the fœtus may be inherited from the father or from the mother. It may also be transmitted from the mother, and produce similar manifestations in the fœtus, if the mother is infected during the earlier months of pregnancy. If the infection is within the last two or three months, the child frequently escapes.* Syphilis may kill the fœtus, either by the affections of the placenta which have been already described, or by its direct effect upon the fœtus itself. It is the commonest cause of repeated abortions and miscarriages. Syphilis in the fœtus shows itself chiefly in the general nutrition, the skin, the viscera, and the bones. If the fœtus has perished before birth, it is frequently wasted and macerated when expelled, often at about the fifth month, and the skin may be detached in large patches. Even when born alive it is puny and ill nourished. The most characteristic eruption of the skin is pemphigus, affecting especially the palms of the hands and feet, but sometimes other parts of the body also. This may lead to detachment of large flakes of skin even in the living fœtus. Copper-coloured stains, condylomata, mucous patches, and erosions and cracks around the mouth, are also observed at birth. The viscera chiefly affected are the thymus, lungs, liver, pancreas, and spleen. In the thymus abscesses may be formed, and the organ may also be enlarged. In the other organs above-mentioned, the changes are chiefly of two kinds which may be found together or separately. These are interstitial deposits of cellular or fibroid tissue causing enlargement with elastic induration of the organ, and gummata in the form of granules or small patches. Sometimes the gummata break down into small abscesses. Peritonitis, usually secondary to visceral lesions, is common. The most constant of all the manifestations of syphilis in the fœtus is said to be an inflammation in the long bones of the limbs at the junction of the cartilage of the epiphysis with the bone. This begins with proliferation of the cartilage cells, followed by calcareous infiltration and caseous change. Eventually there is thickening of the periosteum and perichondrium, and spontaneous separation of the epiphysis from the bone may sometimes result.

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* See, however, the section on Syphilis in Chapter XXIII.

Treatment.—When either parent shows signs of syphilis; when previous abortions have occurred, attributable to syphilis; or when the previous child has suffered from congenital syphilis, the mother should be treated during pregnancy with the view that the drug may reach also the fœtal circulation. Perchloride of mercury may be given three times a day after meals in doses of $\frac{1}{12}$ grain, combined with a little hydrochloric acid and syrup.

Rachitis.—In rare cases the fœtus is affected by a disease closely resembling, and apparently identical with, the rachitis of children. There is great deficiency of earthy material throughout all the bones, and the limbs are stunted, thickened, and bent. The abdomen is swollen and the liver enlarged. At the epiphyses of the long bones and of the ribs there is thickening which, according to Spiegelberg, is due to an excessive proliferation of the cells engaged in the formation of bone, identical with that which occurs in ordinary rachitis. Depaul, however, contends that the disease is not the same as the rachitis of children. The general changes of shape in the bones are similar to those produced by ordinary rachitis. The stunted and thickened appearance of the limbs, however, is much more marked, and the head is unduly large in proportion to the body and limbs. Sometimes the cranial bones are imperfectly ossified, and sometimes there is hydrocephalus. There may be fractures of the bones (see p. 375), which are sometimes found united, or partially united, at the time of birth. Since the weight of the body cannot come into play, the changes of shape in the skeleton, including a flattening of the pelvis in its antero-posterior diameter, and widening of the pubic arch, must be due to the traction and pressure of muscles and ligaments combined with external pressure. The bones in early fœtal life will have less power of resisting these forces than those of a child similarly affected.

The causation of intra-uterine rachitis is obscure, since, in the recorded cases, malnutrition on the mother's part was not apparent. The disease is especially liable to occur in twin pregnancy. One fœtus only has been found affected, when the placentæ were separate; and both fœtuses when there was a single conjoint placenta. This is evidence in favour of the view of Spiegelberg, that the cause is not so much any malnutrition in the mother, as some unknown condition in the placenta.

Conditions of the fœtus which cause obstruction to labour, such as hydrocephalus, ascites, and others, will be considered hereafter (see Chapter XXVIII.).

Intra-uterine death of the fœtus.—The fœtus may die from numberless causes, from any disease or morbid state either of itself or of the placenta or membranes, from faults of development, probably even from mere inherent deficiency of vitality, from any cause preventing an adequate supply of nutriment, from poisons transmitted from the mother, either those of zymotic diseases, or mineral poisons, such as lead or arsenic, and from external injuries. There is evidence also that a febrile condition in the mother may of itself destroy the fœtus, apart from the presence of any poison. When the mother is affected by fever, the pulse and temperature of the fœtus rise in like proportion, the temperature of the fœtus being always nearly a degree above that of the mother. Experiments on animals have shown that artificial elevation of temperature destroys the fœtus before the mother dies, and that a temperature so produced in the mother as high as 106° is always fatal to the fœtus. Danger to the fœtus may be considered to have begun when the temperature has reached 104°.

Sometimes the fœtus dies without any obvious cause, and in some instances this occurrence has been repeated at about the same time of pregnancy in a number of successive pregnancies. Syphilis is the commonest cause of intra-uterine death not otherwise explained. When a macerated fœtus is expelled, evidence of syphilis may be found in the majority of cases, on a careful examination of it, especially in regard to the epiphyses of the long bones of the limbs. In the case of repeated death of the fœtus at about the same time of pregnancy, syphilis appears also to be the most usual cause. In some instances, however, such a result has been attributed to malnutrition of the mother, or to disease of the placenta not due to syphilis but to some other cause, such as pre-existing endometritis. It has been recommended in cases in which the fœtus has repeatedly died in the later months of pregnancy to induce premature labour a little before the time at which death generally occurs. If the suspected cause be syphilis, this proceeding offers little hope of success, since the fœtus would probably already have grave visceral lesions. A better plan is to give a course of mercurial treatment to both parents in the interval of pregnancy, and to the mother during pregnancy. If, however, the probability of syphilis be excluded, and, more especially, if examination of the fœtus on a previous occasion has shown it to be in itself healthy, the plan of inducing labour some time after the seventh month may be adopted.

Retention of dead fœtus in utero; maceration, mummification.—As a rule the death of the embryo or fœtus is followed by the expulsion of the ovum in from two days up to two or three weeks. For degenerative changes in the placenta and membranes follow the fœtal death; the ovum begins to act like a foreign body, and excites the uterus to expel it. There is an exception to this rule in the case of twin or triplet pregnancy. In this case, if one ovum dies, it is more usual for the blighted ovum to be retained until the birth of the living child, especially if the placentæ are conjoined, or united at their borders. This is probably to be explained on the ground that the degenerated placenta occupies a relatively small part of the interior uterine surface (a condition usually the actual cause of the death of the ovum), while the main part of that surface remains still in contact with living and growing membranes. In some cases even of single pregnancy, a blighted ovum or dead fœtus may be retained for months within the uterus, especially if its death has taken place in the earlier part of pregnancy. The cause probably is either that the uterine irritability is less than usual, or that the placenta remains closely attached to the uterine wall, and so maintains a certain degree of vitality. Or these two causes may be in operation together. In the great majority of cases, uterine pains come on at what would have been the full term of pregnancy, if not before, and the ovum is then expelled. Much more frequently, a macerated fœtus is expelled before the end of the seventh month.

Maceration is the most usual change which follows the death of the fœtus. This is a slow moist decomposition, but not putrefaction, in the presence of the liquor amnii, but with the exclusion of air. An early embryo may become entirely dissolved. With a larger fœtus the cuticle becomes loosened, detached in large pieces, or raised in blebs. The cutis and deeper tissues are stained brownish red, from infiltration with blood pigment. Fatty degeneration in the tissues and deposition of fat crystals take place, especially near the surface. The attachment of the bones, especially of the cranial bones, is loosened. The tissues become soft and lacerable, and the whole body loses its tonicity, so that it may be squeezed into almost any shape. The presentation, in consequence is very apt to be an abnormal one. The brain is converted into a soft pulpy mass, and the viscera eventually lose their anatomical characters. The tissues are generally œdematous, and turbid reddish fluid collects in the serous cavities. The liquor amnii becomes turbid and greenish or brownish, and has a sickly disagreeable smell, not, however, that of putrefaction. The funis is soft, smooth, and lacerable, and is stained brownish red, like the cutis. The placenta is pale, yellowish, and friable. If the membranes become ruptured, and air and germs obtain an entry, putrefaction generally takes place quickly, within a few days.

Mummification is a term applied to a drier form of change in the fœtus. It occurs especially in twin pregnancy, when the ovum has become blighted, and is to be ascribed partly to the gradual death of the fœtus from deficient blood supply, partly to the effect of pressure. The tissues are here found shrunken instead of œdematous. The skin lies almost immediately on the bones, only scanty muscles intervening, and the areolar tissue seems to have disappeared (Fig. 144). The placenta is pale, small, and tough. The tissues also are comparatively tough, and the fœtus looks as if it had been shrivelled up by being kept in spirit. The fœtus is generally found squeezed up or flattened, and, in the latter case, has been termed "*fœtus papyraceus.*" A similar result may sometimes happen in single pregnancy if the fœtus dies gradually from such a cause as torsion or stenosis of the funis, the liquor amnii being scanty. Possibly also it may occur if the liquor amnii escapes by a small opening, without entry of air, and the placenta retains some vitality by adhesion to the uterine wall.

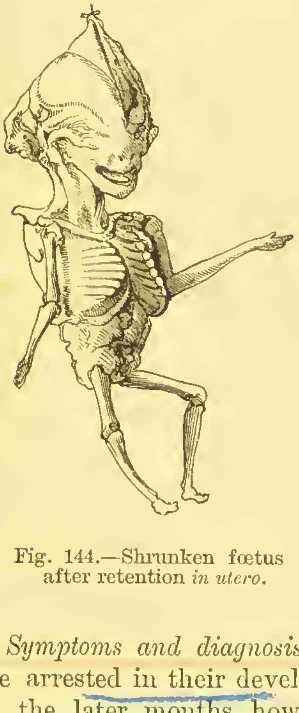

Fig. 144.—Shrunken fœtus after retention *in utero.*

Symptoms and diagnosis of the death of the fœtus.—The breasts are arrested in their development, become flaccid, and soon shrink. In the later months, however, the sign of the death of the fœtus may be a temporary secretion of milk, like that which follows its expulsion, followed later by recession of the breasts. Other reflex symptoms, such as nausea and vomiting, which depend upon the growth of the uterus, often cease. The enlargement of the abdomen and uterus ceases, except in the case of the vesicular mole. The symptoms and signs which are found in the earlier months of pregnancy in the case of a blighted ovum or carneous mole have already been described (see p. 364). Sometimes a subjective feeling of coldness in the site of the uterus is given as a sign of death of the fœtus, especially when pregnancy is somewhat more advanced. This is not much to be relied upon. The ovum cannot of course become colder than surrounding parts, although it ceases to be a source of heat.

In the later months, the more apparent cessation of fœtal movements must not be taken as evidence of the child's death, for it may frequently remain quiet for a considerable time. Nor is reliance to be placed upon failure to hear the fœtal heart upon a particular occasion. If, however, toward the end of pregnancy a skilled observer has previously heard the fœtal heart easily, and afterwards fails to hear it on repeated trials, while movements also can no longer be detected, the presumption of the death of the fœtus is considerable. In general, before making a positive diagnosis, it is desirable to wait until arrest in the enlargement of the uterus and recession in the development of the breasts become manifest.

Treatment.—The treatment in the earlier months of pregnancy has already been described (see p. 364). In the later months, when the diagnosis has been made absolute by sufficient lapse of time, and especially if there is any sanguineous or offensive discharge, the membranes may be punctured, and tents or hydrostatic dilators used afterwards, if required.

Missed labour.—The term "missed labour" has been applied to cases in which it has been supposed that, the fœtus being within the uterus, for some reason or other, parturition does not take place at the usual time, but the fœtus dies, and is retained indefinitely within the uterus, without immediately causing the death of the mother. An abortive attempt at labour, leading to no result, or only to the escape of the liquor amnii, has been supposed to have occurred in some such cases, but this is not essential to the conception of "missed labour." The occurrence is, at any rate, of extreme rarity, and doubts have existed whether all cases so described may not have been misinterpreted instances of ectopic fœtation, that is, either extra-uterine, tubo-uterine, or in an abnormal uterus. In the classical case of Dr. Oldham,* who first introduced the term, the fœtus became disorganised, and converted into a mass of bones and adipocerous matter (see Fig. 145), portions of which were discharged or removed through the os uteri for the course of three months from the date of the full term of pregnancy. The woman then died, and the mass was found in an imperfect cyst formed by the abdominal parietes and the posterior uterine wall, the anterior uterine wall having been apparently worn through. This case is therefore open to the interpretation that an extra-uterine sac may have ruptured into the uterus, although Dr. Oldham recorded that he felt the fœtus *in utero* during life. In a case reported by the author,* which had at first been diagnosed as one of missed labour, a watery discharge escaped through the cervix uteri, two months after the date of full term. After dilatation by a tent, the fœtus was felt presenting by the finger passed through the cervix at an opening resembling the internal os. The woman died, and the fœtus was found to be in an extra-uterine sac which had formed an opening just at the convexity of the bend in a retroflexed uterine canal. Dr. Barnes † describes a case in which the fœtus died probably at the eighth month of pregnancy, was retained till seven months after full term, and in which he was convinced by introduction of the hand that it was situated in the uterus, though there was no verification by autopsy, the woman having

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* Path. Trans., Vol. I.

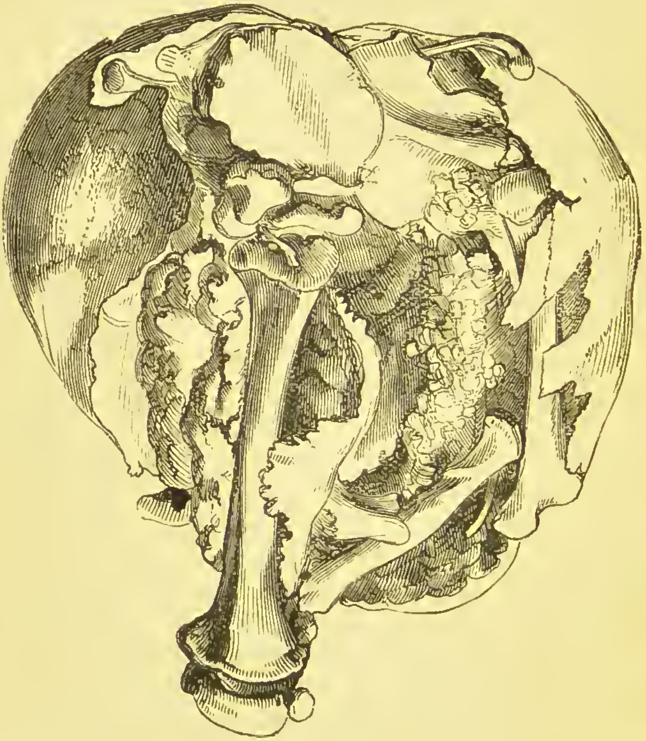

Fig. 145.—Contents of cyst, in Dr. Oldham's case of missed labour.

' Obstet. Trans., Vol. XVII.
† Obstet. Trans., Vol. XXIII.

recovered. Dr. Barnes concludes that there is no evidence of the occurrence of missed labour, unless when the fœtus has died before the full term of pregnancy. Positive *post-mortem* evidence even of this is not yet forthcoming, but the fact that a similar occurrence has been observed in cows and in ewes is in favour of its possibility.

The treatment of missed labour, if in any case it is established that the fœtus is certainly in the uterus, is to dilate the cervix by laminaria tents and hydrostatic dilators, and to empty the uterus with the aid of an anæsthetic, the portions of the fœtus being removed by the fingers, or by whatever forceps are found most conveniently to grasp them.

CHAPTER XXIII.

ACCIDENTAL COMPLICATIONS OF PREGNANCY.

The following are diseases which occur independently of pregnancy, but which are of such a nature that they have a special influence on pregnancy, or pregnancy upon them.

Chronic cardiac diseases.—The physiological changes in the heart which result from pregnancy have already been explained. The increased volume of the blood and increased arterial tension cause some dilatation, especially of the left ventricle. This leads to compensatory hypertrophy, which may proceed so far as actually to improve the circulation (see p. 115). When, however, chronic valvular disease exists, the case is different. A degree of compensation by hypertrophy may then have been attained, sufficient to maintain the circulation under ordinary circumstances. But when a further dilatation and increase of tension is produced by pregnancy, the powers of nutrition may be unable to respond by producing a further compensation by hypertrophy. This is rendered more probable by the fact that a certain degree of anæmia is usual in pregnancy, and that this anæmia is not unfrequently carried to a pathological degree, especially when vomiting or other digestive disturbances occur. The embarrassment of the lungs, and consequent tendency to inflammatory changes in them, which result from the cardiac disease, are also increased by the interference with respiration due to the abdominal distension. A still further strain is placed upon the diseased heart by the process of labour. This is proved by the fact that, in many recorded cases, patients who have survived pregnancy and parturition have succumbed within two or three weeks after delivery. It is probable that fresh inflammation may be set up in the valves by the strain put upon them by the efforts of labour. During the labour itself, the heart's action often becomes very irregular, and the patient cyanotic.

When the heart disease is at all grave, pregnancy therefore proves a very serious complication. Out of 31 cases collected by

Angus Macdonald,* 17, or 55 per cent., proved fatal. Many of these cases, however, were specially severe. Premature labour frequently comes on spontaneously, when symptoms are grave, and this occurrence, in several cases, anticipated the execution of the physician's resolve to induce labour. According to Macdonald, cases of mitral regurgitation prove the least grave, those of mitral contraction the most grave. This is probably explained by the fact that, in the latter case, the tension which generally produces dilatation and hypertrophy of the left ventricle is all expended upon the left auricle, and thence thrown back upon the lungs and right heart. In aortic regurgitation, the symptoms were severe, but were generally relieved after delivery, if the patient had passed safely through that stage.

Prophylaxis.—In all cases of chronic heart disease which produce any marked symptoms, such as dyspnœa, palpitation, œdema, or notable alteration of pulse, the physician should advise the patient not to marry, if his opinion is asked.

Treatment.—The general management of the cardiac condition, and treatment by drugs, are the same as when there is no pregnancy. All exciting causes of pulmonary complications should be especially avoided. In labour, early assistance by forceps or version should be given, and bearing-down efforts of the patient restrained as much as possible. Chloroform, to the usual partial extent, may generally be given without increase of danger. When the symptoms are severe, induction of premature labour or abortion seems to be rational treatment. The physician should, however, warn the patient and her friends that the immediate sequel of labour, whether spontaneous or induced, may be aggravation of symptoms. Macdonald held that premature labour should seldom or never be recommended, because it is likely to do greater harm than good, by disturbing the action of the heart and the condition of the lungs.

Acute endocarditis.—Acute endocarditis may occur in pregnancy as at other times, and sometimes it seems to be promoted by a peculiar condition of the blood in pregnancy, though this is more likely to happen after delivery. More frequently it happens that, in consequence of extra strain in pregnancy, fresh valvular inflammation supervenes upon chronic disease. This may take either the ordinary plastic or the ulcerative form. Embolism is then apt to occur, and in this way apoplexy and paralysis may be produced.

Phthisis.—The opinion has been held by many that pregnancy acts as a prophylactic against phthisis in those predisposed to that disease. There is no evidence, however, that this is really the case in general. It may be true in some of those cases in which pregnancy appears to improve the general health, but it probably more frequently occurs that impairment of health, from some of the disturbances of pregnancy, favours the onset of the disease. Pregnancy generally has an unfavourable influence on the course of a phthisis already existing, although to this rule there are many exceptions. The puerperal state and lactation have a much more decidedly unfavourable influence. As a rule, abortion or premature labour occurs spontaneously only when the condition of the mother is becoming extreme, or when her blood is insufficiently aërated. In the later stages of phthisis amenorrhœa results, and pregnancy is not likely to occur, but in the earlier or quiescent stages of the chronic form of the disease this is not the case. Phthisical women should be advised not to marry, both on account of the increased risk to themselves, the probably phthisical predisposition of their children, and the possible communication of contagion to their husbands. Labour, in phthisical women, should receive early assistance by the use of forceps. Artificial induction of abortion has been performed on account of phthisis. But the general opinion is that the influence of the pregnancy upon the phthisis is so uncertain that, as a rule at any rate, this operation is not justifiable. The same conclusion will apply even to the induction of premature labour.

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* "Heart Disease during Pregnancy," 1878.

Acute lobar pneumonia.—Pneumonia, which in other respects has a close analogy to zymotic diseases, shows this character also in its relation to pregnancy. Pregnancy seems to afford a certain protection against its onset, but, when it does occur, its severity and danger are increased. The gravity of the disease is greater, the further advanced is the pregnancy. This may partly be explained by the interference of the distended abdomen with the descent of the diaphragm and freedom of respiration, although the capacity of the chest is not actually diminished, as was formerly supposed. Pneumonia often leads to abortion or premature labour. This may be due to imperfect oxygenation of blood, to the general effect of the acute disease on the mother's system, or to the death of the fœtus produced by the high temperature (see p. 378). In the latter case, delivery may be delayed until the acute stage has subsided. Premature labour, either induced or spontaneous, renders the prognosis much more unfavourable. As will be explained in the chapter on puerperal fevers, there is some evidence that pneumonia, existing before delivery, may merge into puerperal septicæmia, or, at any rate, predispose to that disease.

Treatment.—Premature labour should on no account be induced, but the onset of labour should be averted if possible. If labour does come on near full term, early aid should be given by forceps, if called for. Digitalis is often useful to maintain the vigour of the heart, and generally stimulant treatment is likely to be called for.

Jaundice.—Jaundice is a rare affection in pregnancy, but has great interest from the tendency which exists for apparently simple jaundice to develop into the fatal disease, acute yellow atrophy of the liver. Sometimes such a development takes place only after delivery. Of seven cases of jaundice in pregnancy met with by Spiegelberg,* two were cases of acute yellow atrophy.

Simple Jaundice.—Simple jaundice may run an ordinary course during pregnancy. As a rule, it does not lead to abortion or premature labour, but this result does sometimes happen. The fœtus and liquor amnii are sometimes, but not always, stained yellow with bile pigment.

Acute atrophy of the liver.—Of 31 cases of acute atrophy of the liver, 11 occurred in pregnant women (Frerichs). The disease may occur as early as the third month of pregnancy, but is commoner towards the later months. The disease generally begins like simple jaundice; then grave constitutional symptoms supervene, elevation of pulse and temperature, delirium, coma, and generally hæmorrhages. The diminution of size of the liver may be detected.

Pathological anatomy.—The liver-cells are, in great measure, destroyed. There is also degeneration of the muscles, especially of that of the heart. Fatty degeneration of the kidney-cells has also been described in some cases. Abortion or premature labour often comes on, and the fœtus and liquor amnii are found stained with bile pigment.

Causation.—It is generally believed that the disease is due to some form of toxæmia, but the exact mode of origin of the poison is obscure. German authorities hold that it is developed out of a simple form of jaundice by the poisonous influence of biliary products, especially the bile acids, retained in the blood. It would thus be promoted by any deficient action of the kidneys, upon which the duty chiefly falls, in jaundice, of excreting such products. Pregnancy would aid in its production, because the kidneys are then apt to have their function disturbed by the extra work thrown upon them, and the interference with their circulation.

It is not, however, clear that the apparently simple form of jaundice, with which acute atrophy of the liver begins, is of the obstructive kind. The action of the liver may be embarrassed, like that of the kidneys, by the modification of the blood in pregnancy, combined with mechanical influence on the circulation. The influence of abdominal pressure appears to be shown by the fact that the majority of cases of acute atrophy in pregnancy occur in primigravidæ. The sequence may therefore be that, first, jaundice is produced by these disturbances of the liver, and, secondly, that the toxæmic condition is increased by retention of biliary products. In some cases severe mental shock or mental distress appears to be an exciting cause. According to Spiegelberg, the symptoms of acute atrophy are often preceded by hæmorrhage from the uterus or other parts, which may have a depressing influence. In very rare instances an apparent epidemic of acute atrophy of the liver in pregnant women has been recorded. In these cases, therefore, there must apparently have been some blood poison entering from without, and probably depending upon some form of microbe.

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* "Lehrbuch der Geburtshülfe," 2nd ed., p. 246.

Treatment.—Simple jaundice in pregnancy may be treated in the ordinary way. Moderate use of purgatives and diuretics is desirable. Acute atrophy when once developed is hopeless. If in simple jaundice hæmorrhages occur, or the urine is albuminous or deficient in urea, or there are any other grave constitutional symptoms, such as coma or mental affection, thus indicating a danger that acute atrophy may supervene, the question of induction of premature labour or abortion should be considered. It appears that the effect of pregnancy, acting either mechanically or through the nervous system, may compound with organic conditions in the liver. In one instance I induced premature labour for the jaundice of pregnancy, the patient being deeply comatose, and acute atrophy being feared. The patient rapidly recovered, and the jaundice disappeared. Later, however, it proved to have been due to cancer of the liver, from which she eventually died.

Diabetes.—Diabetes is another disease affected by pregnancy. Cases have been recorded in which diabetes has recurred in successive pregnancies, and has been absent during the intervals, as is sometimes the case with albuminuria. Sometimes pregnancy occurs in a diabetic patient, and runs its course undisturbed; but generally the diabetes is aggravated, and the complication is of grave import both to mother and child. Of cases collected by Matthews Duncan,* namely, 22 pregnancies in 15 mothers, 4 ended fatally during the puerperal period, premature labour having been induced in one of these. Hydramnios was frequent, and in one case sugar was found in the liquor amnii. In 7 out of 19 cases the child died during the pregnancy, after reaching viable age, and in 2 more it died a few hours after birth.

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* Obstet. Trans., Vol. XXIV.

These facts, as well as those connected with acute atrophy of the liver, appear to indicate that pregnancy is apt to have a pathological influence on the liver as well as on the kidneys. It is to be remembered that physiological glycosuria occurs in the puerperal woman, and, more rarely, before delivery; but if the theory be true that the sugar in these cases is due to the resorption of lactose from the milk (see p. 270), such glycosuria is a distinct thing from the diabetes here described.

Bronchocele.—Cases have been observed in which a bronchocele has occurred for the first time or increased during pregnancy. It is a question how far the causation depends upon the increased vascular tension of pregnancy, and how far upon a reflex nervous influence. The fact that bronchocele, especially exophthalmic goitre, is sometimes associated with uterine disturbance or hysteria, apart from pregnancy, makes it probable that nervous influence may play some part in the matter. A temporary increase of the swelling of the thyroid is apt to be produced by the straining of labour; but the enlargement generally subsides to a great extent, though not altogether, after delivery.

Hæmorrhages.—Women who are liable to hæmorrhages have this liability increased by the increased vascular tension of pregnancy. In some cases, also, the deteriorated quality of the blood may have an influence. Thus hæmoptysis occasionally occurs during pregnancy; and in that condition it has not the same significance as at other times in indicating the probable existence of phthisis. Again, epistaxis and bleeding from the alimentary canal, especially from the rectum and stomach, are not uncommon. Cerebral hæmorrhage, producing paralysis, sometimes occurs, but this is more especially associated with albuminuria. Distended varices sometimes rupture on the surface, and pelvic hæmatocele, from rupture of a vessel near the uterus, has occasionally been recorded.

Purpura Hæmorrhagica has been described as occurring with special severity in pregnancy. Its causation has been attributed to profound mental disturbance, or to hard work with insufficient nourishment. According to some authorities, the disease is a form of bacterial infection. The fœtus has been found to remain exempt from it.

Ovarian tumours.—Ovarian tumours of small size may not interfere with the course of pregnancy or parturition, provided they do not occupy the pelvis. If the tumour is of considerable size, the complication is a serious one. The tension may become so great before the end of pregnancy, that vital functions are interfered with. Other dangers also exist. The tumour may rupture under the influence of pressure. The presence of the enlarged uterus may cause twisting of the pedicle, or interference with its circulation. Then follow necrotic and inflammatory changes in the tumour. The obstruction to labour which an ovarian tumour occupying the pelvis may cause, will be considered hereafter. (See Chapter XXVIII.)

Treatment.—In the case of a tumour likely to require interference before the end of pregnancy, the choice will lie between ovariotomy, induction of premature labour or abortion, and tapping the tumour. Ovariotomy during pregnancy has been scarcely less successful than apart from pregnancy. Premature delivery has followed in several cases, especially if the patient has been advanced beyond the fourth month, but she has generally recovered, notwithstanding. In a case recorded by the author, in which the operation was performed during the sixth month, the patient went to full term.* The conclusion appears to be that, if the operation can be performed by a specialist practised in ovariotomy, ovariotomy is the best treatment, especially during the earlier months. After the fifth or sixth month, if adhesions near the uterus are probable, it may be preferable to adopt other means, because the adhesions are then likely to be highly vascular. If symptoms of rupture of the tumour or twisting of the pedicle should appear, ovariotomy should not be delayed. Failing ovariotomy, if the tumour can be conveniently tapped, and if it appears to be mainly unilocular, and the full term of pregnancy is not far off, tapping should be performed. Otherwise, premature labour, or, if necessary, abortion, should be induced, and ovariotomy should be deferred until the puerperal period has quite passed.

Fibroid tumours of the uterus.—Although fibroid tumours of the uterus tend to prevent pregnancy, yet pregnancy does sometimes occur, notwithstanding the presence of the fibroids, especially if the tumours are subperitoneal. The tumours then generally grow in conjunction with the growth of the uterus, and diminish again after delivery, as the uterus becomes involuted. A difficulty of diagnosis may arise during pregnancy, and the suspicion may be raised of the presence of extra-uterine fœtation on account of the irregularity of the tumour containing the fœtus. In other cases the fibroid tumour becomes softened during pregnancy, and may then be mistaken for an ovarian tumour. When the fibroids are external, pregnancy and parturition are often undisturbed ; when they are in the wall of the uterus, there is a tendency to inertia of the uterus, and to post-partum hæmorrhage.

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* Brit. Med. Journ., 1880

Treatment.—Interference during pregnancy is generally required only if the tumour, by occupying the pelvis, is likely to obstruct delivery. This question will be considered hereafter. (See Chapter XXVII.) If, however, the tumour is so large that it is likely to cause serious pressure symptoms before the child is viable, it may be desirable to remove the uterus by hysterectomy as early as possible. Induction of abortion may be an alternative, but should not be performed if the cavity of the uterus cannot be reached for complete evacuation of the ovum. In all cases special eare should be taken to secure firm contraction of the uterus after delivery.

Surgical operations.—The effect of a surgical operation in pregnancy varies greatly according to the susceptibility of the woman to reflex influence. In one case the extraction of a tooth may bring on labour: in another ovariotomy, or amputation of the thigh, may produce no such result. But after serious operations abortion or premature labour follows in a considerable proportion of cases (according to Cohnstein's statistics, in 45·5 per cent.). The tendency appears to be greater in the third and fourth and in the last two months, less in the middle months. The cause may be reflex influence, or, less frequently, the fever following the operation. Operations on the vagina or in the neighbourhood of the uterus are more likely to interrupt pregnancy. Such operations are also likely to be attended with considerable hæmorrhage. Pregnancy does not appear to be unfavourable to the recovery of the patient, but the puerperal state is so. It is therefore unfavourable if premature labour follows very quickly upon a severe operation.

It is better to defer operations not of an urgent character until after delivery, unless the condition for which the operation is required is aggravated by pregnancy, or is likely to cause difficulty in delivery. So far as possible, no serious operation should be performed during the puerperal period.

Ague.—The relation of malarial fever to pregnancy is, in some degree, similar to that of zymotic diseases. It is met with but rarely, but when it does occur, it is aggravated. Latent malarial infection may also become again active during pregnancy. This is more likely to happen in the puerperal state, at which time fever, ascribed to malaria, is relatively common in malarial districts. At this time also, the charaeter of the fever is modified; instead of being intermittent, it becomes remittent, and the paroxysms become irregular. Malarial fever not unfrequently leads to abortion or premature delivery. In some cases there has been evidence of its eommunication to the fœtus, which may die before, or soon after, delivery.

Syphilis.—The effects of syphilis upon the fœtus and the placenta have already been described. Syphilis may be inherited from either parent, or both, even if the disease exists only in a latent condition. In the case of untreated syphilis, syphilitic children may be procreated for ten years or more, the intensity of the infection diminishing with the lapse of time.

If a pregnant woman acquires syphilis, the local manifestations in the neighbourhood of the genital organs are more severe than usual, in consequence of the hyperæmia of those parts. The constitutional disease is generally mild. A woman impregnated by a husband who has latent syphilis, may acquire the disease for the first time from the fœtus. In this case the symptoms are very mild, and only those manifestations which are generally late ones may be shown. Some authorities deny the communication of syphilis from the fœtus to the mother, and *vice versâ*. But what is known as Colles' law is admitted as a general rule, although exceptions have been recorded. This is, that a woman is never infected by nursing her own child suffering from hereditary syphilis, though another woman is likely to be so, and though she may never have shown signs of the disease. It is not certain whether this implies that all such mothers have had the disease slightly, though unobserved, or that they acquire immunity though never infected. But in either case it proves that the syphilitic poison in the fœtus affects the mother. When a pregnant woman acquires syphilis, the fœtus may have symptoms similar to those of the hereditary disease. It has generally been thought that, if the infection takes place in the later months of pregnancy, the fœtus is likely to escape. But Hutchinson* has recorded cases in which the mother was infected within the last few weeks of pregnancy, and in which the child, after birth, had symptoms like the ordinary hereditary disease.

Treatment.—If syphilis is acquired during pregnancy, mercurial treatment throughout the remainder of pregnancy is of importance for the sake of the child, as well as for that of the mother. The formula given at p. 405 may be used.

Tetanus.—Tetanus during pregnancy has been observed chiefly in the earlier months; and pregnant women appear to have an increased liability to the disease, at any rate during the first half of pregnancy. It has generally followed some minor operation, or some manipulation in connection with the induction of abortion. The gravity of the disease is the same as that of puerperal tetanus.

Tetany.—Tetany is a disease to which pregnancy and lactation specially predispose, but more particularly lactation. The prognosis is almost invariably favourable, but a fatal result has been recorded. It may recur in successive pregnancies. Tetany is distinguished from tetanus, not only by its mildness, but by the fact that it begins in the extremities and advances centripetally. The flexor muscles and interossei in the hands and feet are most affected.

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* Medical Times and Gazette, 1878.

ZYMOTIC DISEASES.

Any zymotic disease may occur during pregnancy. But in general the pregnant woman appears to be less liable than others to the outbreak of a zymotic disease, while, on the other hand, the puerperal woman is much more liable. This rule does not however apply equally to all diseases. It is most marked in the case of scarlatina, and probably least marked in that of small-pox. Any severe zymotic disease is rendered more grave by pregnancy, especially in the later months, but still more so by the puerperal state. Most zymotic diseases are apt to lead to premature labour or abortion. There are three elements which may tend toward this result; first, the death of the fœtus from the high temperature; secondly, the effect of the severity of the disease upon the mother; thirdly, the effect on the mother of the special zymotic poison concerned. That the third element is actually operative is proved by the special tendency of small-pox to produce premature labour, even when it runs a mild course, and when the child is born alive. The mode of operation is, in some cases, the production of hæmorrhage in the uterus or placenta. The puerperal state being much more unfavourable than that of pregnancy, the longer abortion or premature labour is deferred the better it is for the mother. Labour should not therefore be induced in any case, although, in small-pox, when the child is viable, induction might give it a better chance of surviving.

Variola.—Small-pox has been observed in pregnancy oftener than most zymotic diseases. Confluent or unmodified small-pox is very dangerous to the mother, and proves fatal in the majority of cases. It tends to assume the hæmorrhagic form, and specially to cause uterine hæmorrhage. In almost all cases it leads to abortion or premature labour and the death of the fœtus. Modified or discrete small-pox generally runs a favourable course, but even this leads to abortion or premature labour in most cases, although not so constantly as the more severe disease.

In a certain proportion of cases, but not invariably, the fœtus is affected by the disease *in utero*. Sometimes it is born with pustules upon it. In other cases, when it is delivered at a later stage, the scars of pustules are visible. When premature labour occurs early in the disease, the child may become affected a few days after delivery. Sometimes, although not apparently affected, the child dies shortly after birth. In other cases, the child, which has shown no trace of the disease, is found to be insusceptible to vaccination. Cases even have been recorded in which it has been supposed that the child was affected by the disease *in utero*, or very shortly after birth, during epidemics of small-pox, although the mother did not suffer from it, or in which one of twins *in utero* took the disease from the mother while the other escaped.

Vaccination during pregnancy appears to run its course as usual. In an epidemic of small-pox therefore, pregnant women, who have not been re-vaccinated, should undergo that operation. Vaccination should not be performed very shortly after delivery, since even a very slight zymotic poison may then have an unfavourable influence.

Scarlatina.—Scarlatina is very rare during pregnancy, especially as compared with its frequency during the few days after delivery. According to some, the incubation may be prolonged for weeks and months during pregnancy, and the outbreak only take place after delivery (see section on Scarlatina in Chapter XXXIX.). Mild cases of scarlatina may run a favourable course. If the fever is high, abortion or premature labour generally follows, and then the danger is greatly increased, as in ordinary puerperal scarlatina. It has been inferred that the disease may be conveyed to the fœtus *in utero*, because the child, at or shortly after birth, has sometimes shown desquamation of the skin or other sequelæ of the disease.

Measles.—Measles rarely occurs in pregnancy. Usually the disease runs an ordinary and mild course. But cases have been recorded in which it has been unusually severe, tending towards a hæmorrhagic type, or complicated by pneumonia. In such cases premature labour or abortion frequently follows. The child has been born with the eruption of measles.

Erysipelas.—Erysipelas is not very common in pregnancy. It does not seem to prove specially dangerous, unless premature labour is the consequence. There is then a serious risk, since the germs of erysipelas are capable of setting up septicæmia; but this may be averted if, by strict antiseptic precautions, conveyance of them to the vagina can be prevented. The risk is much increased if the erysipelas is in the vicinity of the genital canal. Even in cases of erysipelas limited to the head and face, the fœtus at the time of birth has been affected both by cutaneous erysipelas and by septicæmia or pyæmia. It is possible therefore for septic poison to be transmitted to the genital canal through the blood. (See Chapter XXXIX.)

Enteric, typhus, and relapsing fevers.—All these diseases are rare during pregnancy, especially in the later months. Enteric fever leads to premature labour or abortion in the majority of cases. The interruption of pregnancy generally follows at the time when temperature ranges the highest, and the prognosis is rendered more grave in consequence. Severe hæmorrhage is apt to follow after abortion in the earlier months, and it has been thought that the prognosis of the disease is on this account more grave at that time than in the later months. Transmission of enteric fever to the fœtus has been proved by the finding of bacilli in it after death. Relapsing fever, according to Murchision and Zuelzer,* leads to interruption of pregnancy in almost every case. Weber,† however, at St. Petersburg found this happen in only 23 out of 63 cases. Typhus fever is less apt to lead to premature labour or abortion than either of the other two, and its course is not so much modified by pregnancy as that of many zymotic diseases.

Cholera.—It does not appear that pregnancy affords any notable protection against cholera. Accounts differ as to whether the mortality of the disease is increased by the complication. It is said to be both more frequent and more fatal in the later months. Interruption of pregnancy follows in a considerable proportion of cases, and, in others, it is probably only prevented by the early fatal termination. Hæmorrhage into the uterus is apt to occur, and is one of the causes of abortion.

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* "Monatschr. f. Geburtshülfe," Vol. XXX.

† "Berlin Klin. Wochenschr." Vol. VII.

CHAPTER XXIV.

PREMATURE EXPULSION OF THE OVUM.

THE term abortion or miscarriage is applied to premature expulsion of the ovum when this occurs before the time when the child becomes viable, or capable of possibly surviving. After that date, the term premature labour is used. The point of demarcation between the two may be taken as the end of the sixth calendar month, or about 183 days, although there is practically but little chance of the child being reared, if born before the end of the twenty-eighth week, or 196 days. A distinction is sometimes made between abortion and miscarriage, the term abortion being used in the first two or three months of pregnancy, before the placenta is formed, and the term miscarriage from the time when the placenta is formed up to the date when the child is regarded as viable. It is better, however, to consider the terms abortion and miscarriage as synonyms, since no distinct boundary between the two can be assigned, and women themselves generally prefer the word miscarriage to the word abortion.

Premature expulsion of the ovum is one of the commonest of the morbid occurrences of pregnancy. On an average, every woman who has borne children and reached the limit of the child-bearing age has had at least one abortion or premature labour. The proportion of abortions to full-term deliveries has been estimated as being as much as one to five. The attachment of the ovum to the uterine wall is less firm in the early months of pregnancy before the complete formation of the placenta. Hence it is within the first four months of pregnancy that abortions are most common. Within the first few weeks of pregnancy many abortions pass altogether unrecognised, or only suspected. A woman goes a few days, or two or three weeks, beyond the expected time of menstruation; then hæmorrhage occurs, resembling a menstrual period rather more profuse than usual, and an ovum may escape unobserved. If shreds of decidua are detected, these show only a slightly greater development than the shreds of menstrual decidua sometimes passed in menstruation without any conception. It is therefore impossible to estimate accurately the relative frequency of abortions within the first two months. Abortions positively diagnosed occur most frequently between the sixth and the sixteenth week. This fact may be explained not only from early abortions being often undetected, but partly also on the ground that some causes of abortion, such as retroflexion or fibroid tumour of the uterus, only begin to operate when the ovum and uterus have reached a certain size, and that the various diseases of the embryo or membranes which may lead to abortion require a certain time for their development before the embryo is destroyed, or the membranes so much altered as to excite the uterus to expulsion.

Within the first two months of pregnancy, the ovum is most frequently expelled without rupture of the amnion, and the whole of the chorion or rudimentary placenta generally comes away together. The decidua vera, which at this stage is relatively very bulky, may in part come away in connection with the decidua reflexa, or it may be discharged afterwards as a whole, or more frequently, broken up in fragments. After the end of the third month, the amnion is usually ruptured from the effect of the uterine contractions, and the liquor amnii escapes. Then the embryo is expelled first, and the placenta is discharged afterwards, as in labour at full term.

The later the stage of pregnancy reached, the more nearly does the process resemble that of ordinary labour. In the middle months of pregnancy, after the placenta has been formed, but before the formation of that layer of open meshwork which facilitates its separation from the uterine wall (see p. 75), the separation of the placenta is much more difficult, and the uterine action is often insufficient to effect it completely. Hence either the whole or a portion of the placenta is liable to be retained for a longer or shorter period, unless removed artificially. It is from the 10th, and more especially from the 12th, up to about the 20th week that this specially close union exists between the placenta and the uterine wall, and hence an abortion within these limits of time is more likely to lead to grave results than either before or after. In the course of the third month, the ovum may either be ruptured in its expulsion or not, according to circumstances, rupture becoming more probable as the month proceeds. If rupture takes place, retention of the incipient placenta is more likely to occur. It is possible, however, for the amnion enclosing the embryo, with the decidua reflexa, to be expelled entire, leaving the incipient placenta behind. Even the chorion, as well as the amnion, may come away entire, and yet leave the main part of the placenta behind, the chief trunks of the chorionic villi being torn away at their insertion.

Causation.—The uterine contractions, which expel the ovum prematurely, are excited either by a cause acting directly upon the nervous centres, or one which calls out reflex action, or by a combination of the two. Both the excitability of the nerve centres and the tendency to congestion of the uterus are greatest at the epochs which would have been menstrual periods if pregnancy had not occurred, and hence abortion is especially likely to happen at these dates. Different women also vary immensely in the ease with which abortion can be excited. The difference depends chiefly upon the degree of irritability of the nervous system, but, to some extent also, upon the firmness of attachment of the ovum to the uterus. Thus cases are on record in which women have fallen out of windows from a height sufficient to fracture their limbs, and pregnancy has been undisturbed. Ovariotomy and various operations upon the cervix uteri have been performed, nitric acid has been applied to the interior of the uterus in the early weeks of pregnancy, without abortion following. Pregnancy has even established and maintained itself until discovered, notwithstanding the wearing of an intra-uterine stem. On the other hand, with some women, any slight mental or physical disturbance, even the seeing a mouse or a spider, appears to be sufficient to cause abortion. Frequently both a predisposing and an exciting cause can be assigned; and, in the presence of a predisposing cause, the exciting cause may be of the most trivial character.

When once the uterine contractions have caused dilatation of the cervix uteri to a certain extent, and have pressed down the ovum sufficiently to bulge into it, the process of abortion goes on automatically, like that of labour, and resembles labour on a small scale. The reflex irritation caused by pressure of the partially detached ovum upon the cervix, keeps up the rhythmical discharge of energy from the nerve centres.

The most important classification of the causes of abortion is the division into those causes which affect the ovum or uterus and those which act directly upon the mother. In the former class are comprised most of the morbid conditions which have already been described among the diseases of pregnancy. The sub-divisions of this class are the following :—

(1) *Primary morbid conditions of the fœtus, especially those leading to its death.*—If the fœtus dies from any cause, its death is followed by degenerative changes in the chorion or placenta, which no longer continues in such active vital connection with the uterine wall. The ovum then begins to act as a foreign body, and sooner

or later excites the uterus to expel it. The production of extravasations of blood between the ovum and the uterine wall is often an intermediate step. As already mentioned (see p. 378), the expulsion generally takes place within a few weeks. Disease or malnutrition of the fœtus, even without causing its death, may also be associated with similar changes in the membranes, and lead in the same way to abortion. Among the causes leading to the death or malnutrition of the fœtus must be reckoned imperfect fertility on the part of either or both parents. Conception followed by abortion may thus be a stage on the way to complete sterility. Syphilis is one of the most frequent and important causes leading to abortion through death of the fœtus, as well as through disease of the fœtal membranes, and it often produces this effect in successive pregnancies. In the case, therefore, of repeated abortions, without other manifest cause, special inquiry should always be made for any history, or sign of syphilis in either parent. If none such can be found, a diagnosis may sometimes be made by examination of the fœtus (see p. 376).

(2) *Primary morbid conditions of the amnion, chorion or decidua* (see pp. 354—371).—These may either first cause the death of the fœtus, or may directly lead to abortion by irritating the uterus. Those morbid conditions which lead to hæmorrhage, and consequent separation of chorion or placenta, are of special importance. Inflammation and fatty degeneration of the placenta are also frequent causes. Besides morbid conditions produced by disease, separation of placenta and hæmorrhage often arise from mechanical causes. Among these may be mentioned shocks, blows, excessive coitus, the use of instruments for the induction of criminal abortion, violent muscular exertion, and even the effect of coughing, vomiting, or straining at stool.

(3) *Morbid conditions of the uterus.*—These may be displacement, especially retroversion and retroflexion (see p. 341), inflammation of the whole substance of the uterus, the presence of fibroid or other tumours, or fixation by peritoneal adhesions.

Causes affecting the mother directly form the second main class. Certain drugs, called oxtyocics, have more or less power of exciting contractions of the uterus, and by this means may cause abortion. Those most efficacious appear to be ergot, and quinine in large doses (10 grains or more). Digitalis in large doses has perhaps a similar effect. Savin and cantharides have also been taken criminally with this object, and have sometimes had the desired effect. All these drugs are very uncertain in their action, unless there is a predisposition to abort. When ergotism is produced by the poisonous effects of ergot of rye, eaten in bread, abortion may result.

All acute febrile diseases tend to cause abortion. The poison of certain zymotic diseases has, however, a special tendency to produce this effect, apart from the degree of fever, apparently by its influence on the nerve centres. Of these, small-pox is the most marked example. With this effect of a zymotic poison may be compared the similar effect of other poisons, such as lead, excess of carbonic acid in the blood from asphyxia, whether due to mechanical cause or heart or lung disease, and the poison which exists in the blood in renal disease. In the last case abortion or premature labour may be produced directly, as well as through death of the fœtus. Of mineral poisons, lead has been most frequently noted as a cause of abortion, generally through its leading to the death of the fœtus. It appears to be capable of producing this result even by acting in a remote way through the father. For it has been recorded that, when workmen have suffered from lead poisoning, their wives have been specially liable to abort.* Apart from any special poison, expulsion of the ovum is apt to occur in any very grave disease of the mother, especially as a fatal issue is approaching. It happens also sometimes from extreme malnutrition, as in times of famine, or in excessive vomiting of pregnancy. Other general states of the system, such as heart disease, or cirrhosis of liver, may act by producing local hyperæmia and consequent extravasation of blood.

Causes acting through the nervous system.—Abortion is often produced by some sudden or violent emotion, such as fright, grief, anxiety, shock, hearing bad news, or seeing some startling sight. Such emotional causes are specially operative either as exciting causes, when there is already some predisposing cause at work, or in women of highly sensitive and neurotic disposition. Other causes produce a reflex effect through the impressions upon peripheral nerves. Thus continuing to suckle an infant after pregnancy has recurred may lead to abortion, suckling having a well-known tendency to set up uterine contractions. In the same way is to be explained the occasional effect of severe pain, such as toothache, of violent purgatives, of any surgical operation, such as even the extraction of a tooth, but more especially of operations in the neighbourhood of the uterus, of vaginal syringing, or distension of the vagina by a plug or india-rubber dilator.

It has been supposed that in some cases a habit of aborting at about the same date in successive pregnancies has become established. There seems to be no positive proof of the possibility of this, and it is probable that in most such cases there has been some persistent cause, such as syphilis, or endometritis, or uterine displacement, which would naturally lead to abortion at about the same date of pregnancy.

Examination of the ovum will sometimes reveal the cause of the abortion in the shape of inflammation or fatty degeneration in the chorion or decidua, or signs of syphilis in the fœtus.

Symptoms and course of abortion.—The earliest symptom of abortion is usually uterine hæmorrhage. For if the starting-point of the process is uterine contraction, the contraction leads to a partial detachment of the ovum, and consequent rupture of vessels, before the escape of the liquor amnii, and generally before the contraction is manifestly felt as pain. If, on the other hand, the starting-point is extravasation of blood into the fœtal membranes, some of the blood generally breaks through into the decidual cavity, and escapes externally through the cervix. The bleeding may at first be slight and intermittent, but is increased in quantity when uterine contractions become active, and the ovum begins to be more completely separated, and forced down into the cervix. Clots of considerable size are generally passed before the ovum itself is expelled. The bleeding may continue, continuous or intermittent, for some days before the pains come on. In rare cases it may last even for weeks before ending in abortion. Loss of blood is generally greater after the second month, when the cervix has to be dilated to a considerable size before the ovum can pass. It may then be sufficient to cause syncope, and reduce the patient to extreme anæmia, but rarely proves fatal.

Within the first two months the pains of expulsion may not be very different from those of dysmenorrhœa. The later the stage of pregnancy, the more do the pains resemble those of labour at term. Cases of abortion commencing with intermittent pains, due to uterine contraction, and leading to hæmorrhage only in the later stage, are rarer than those in which the hæmorrhage is the first symptom. They are generally cases which occur somewhat later in pregnancy; within the first two months, hæmorrhage almost always occurs at the commencement. In premature labour, or in abortion when pregnancy has nearly reached the sixth month, there is not necessarily any hæmorrhage before the birth of the fœtus, unless the starting-point of the premature expulsion has been extravasation of blood.

Incomplete abortion.—Occasionally, even when the amnion is expelled intact, the incipient placenta remains attached to the uterus. This happens much more frequently when the amnion is ruptured, and the embryo escapes first. If the attachment of the placenta is too firm for the subsequent uterine contractions to break it down, the cervix may close up again, and the uterus become quiescent. Generally contractions recur, and the mass is expelled, after a few hours, or within two or three days, but sometimes it is retained for weeks, or even months. In other cases the main mass of the placenta is expelled immediately or shortly after the embryo, but some portion of it is more adherent, and remains *in utero*.

The result of incomplete abortion varies according to the firmness of attachment of the placenta to the uterus. If there is close attachment over nearly the whole surface, decomposition may be averted. There is then generally but slight hæmorrhage in the first stage of the abortion. Usually some hæmorrhage occurs, either continuously or at intervals, so long as there is placenta retained. In rare cases, when the attachment is very general, there is none at all for a considerable time, and it may even be supposed that pregnancy is continuing. Eventually, often at the date of a menstrual epoch, active uterine contractions come on, separate more of the placenta, and then there is increased hæmorrhage until the whole is either expelled or artificially removed.

More frequently, the union of the placenta is not close enough to preserve its vitality, decomposition occurs, and in a day or two offensive discharge begins. The placenta is generally expelled after a time piecemeal, when the firmness of adhesion has been broken down by putrefaction. The decomposition is much promoted if the finger has been introduced in futile attempts to remove the placenta, and air thereby admitted to the uterus. Sometimes a mass of placental tissue hangs only by a small band of adhesions, and is forced down into the cervix uteri, or through the cervix into the vagina, the body of the uterus contracting up into small bulk. The projecting portion of tissue then most readily becomes putrid. In other cases, again, the portion of placenta, while taking a polypoid form, retains some vitality, or is preserved from decomposition by being retained within the uterus without free access of air, and often becomes coated with fibrin, as well as infiltrated with clot. Such a structure has been called a *placental polypus*, or *fibrinous polypus*. In rare cases the patient recovers without any placental mass ever making its appearance. The placenta must, in such cases, have broken down in shreds.

When decomposition of the placenta occurs, the patient is exposed to the risk of sapræmia and septicæmia, as in the case of retention of portions of placenta after full-term delivery. The disease, however, is not usually so severe, and rarely leads to a fatal result, although sometimes death does occur. Frequently rigors come on within two or three days after the initial stage of the abortion, followed by high temperature, quick pulse, and other constitutional symptoms. Pelvic peritonitis or pelvic cellulitis not unfrequently follows, more especially the former, and often the foundation is laid for chronic uterine malady. As in cases following full-term delivery, the disease may either be simply sapræmia, that is, poisonous effects from the absorption of chemical products of decomposition, or septicæmia proper, in which there is, in addition, the multiplication of septic organisms in the blood or tissues (*see chapter* XXXIX.). In most cases the symptoms subside quickly after removal of the putrid material, and hence it may be presumed that sapræmia only is at any rate the main element in the case. Very severe cases, however, may resemble the gravest forms of puerperal septicæmia, and be marked by diarrhœa, vomiting, severe headache, great abdominal distension, and other signs of general septic peritonitis.

Diagnosis. — Pregnancy existing, the occurrence either of uterine hæmorrhage, or of pains due to rhythmical uterine contractions, is invariably a sign of threatening abortion. The chief difficulty often is to determine whether pregnancy does exist, especially if irregular hæmorrhage has continued for some time. The diagnosis of pregnancy must be made by the ordinary physical signs of that condition, especially, in the early months, by the estimation bimanually of the size, shape, and consistency of the uterus (see pp. 120, 121). A vaginal examination should always be made, the hand being first disinfected as in the case of labour, and, if the os is found dilated, and a part of the ovum presenting there, or expelled into the vagina, the diagnosis will be undoubted, not only of threatened, but of inevitable or partially completed abortion. The only thing likely to be mistaken for an ovum is a soft polypus, or soft fibroid tumour, the lower segment only of which can be reached by the finger. If the whole can be reached, a polypus will be distinguished by having a pedicle, which cannot be separated by the finger, while an ovum, or portion of ovum, is readily detached.

If a substance has been passed per vaginam, examination of this will determine whether an abortion has occurred or not, and whether the whole of the ovum has been expelled. In the absence of an embryo, chorionic villi should be sought for, to decide the fact of abortion. They may be seen most readily if the blood is washed away, and the mass floated out in water. A small portion of anything which resembles villi should then be spread out upon a slide and examined with a low microscopic power. If decidua only can be detected, it must be remembered that a decidua of considerable thickness, sometimes even intact enough to form a cast of the whole uterus, is sometimes passed in membranous dysmenorrhœa.

Generally the decidua reflexa comes away, covering the ovum, and may bring away with it a portion of the decidua vera, attached to its border (*dv*, Fig. 146). Special care should be taken to make sure that the embryonic placenta is not left behind.

If the substance passed have not been kept for examination, doubt may exist whether a part or the whole of the ovum is still retained in the uterus. If the whole still remains, this will generally be revealed by the size of the fundus uteri, estimated bimanually. If a part only is retained, the sanguineous discharge will be excessive in amount, or protracted, or will recur from time to time. The cervix uteri also is more likely to continue patulous if any considerable piece of ovum remains within, and to close up if the whole has been evacuated. Offensive discharge generally indicates some placenta retained and decomposing.

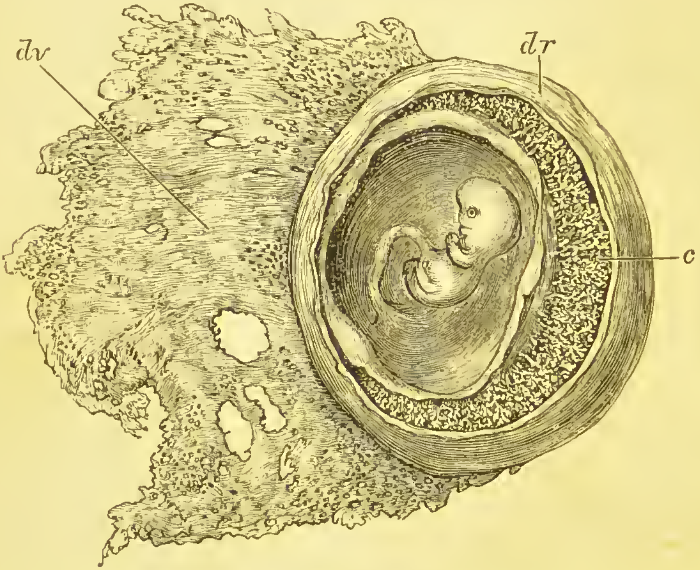

Fig. 146.—Ovum expelled in abortion in third month; *dr*, decidua reflexa, the front portion removed to show interior of ovum; *dv*, decidua vera, showing orifices of uterine glands; *c*, chorion commencing to form placenta.

Prognosis.—A fatal result from abortion is comparatively rare, but does occur occasionally, sometimes from hæmorrhage, more frequently from the effect of septic absorption. It is estimated by Lusk, from the statistics of deaths in New York City, that deaths from all causes after abortion are nearly as numerous in proportion as deaths from metria after delivery at full term, if it be correct to reckon one abortion to every eight to ten full term deliveries. I have known abortion in the third month not only end fatally, but form the starting-point of a series of cases of fatal puerperal septicæmia in the practice of the medical attendant. Death, however is very rare, if abortion is treated efficiently from the outset. Abortion very frequently leaves behind it chronic uterine disease, especially subinvolution. Several causes tend to this result. First, there is frequently some already existing morbid state of the uterus, the cause of the abortion; secondly, women often disregard an abortion, and omit to take sufficient rest and care afterwards; and, thirdly, the natural stimulus of lactation in promoting the contraction and thereby the involution of the uterus is wanting.

The danger of criminal abortion is very much greater than that of spontaneous abortion. This is to be explained partly because instruments are often used by unskilled persons when the object is criminal, partly because the healthy ovum has a closer and more vascular connection with the uterine wall, so that its separation is more likely to be incomplete, or to be attended with profuse bleeding. Of cases of criminal abortion which have been made public, the women have died in not less than half. It must, however, of course be remembered that the death of the woman is generally the circumstance which leads to investigation and detection, and that many other cases remain undetected.

Prophylactic treatment.—When any evidence of syphilis in either parent has been discovered a prolonged course of mercury* should be given to both parents in the intervals of pregnancy, and to the mother throughout pregnancy. In the case of retroflexion or retroversion of the uterus, a pessary should be worn up to about the middle of the fourth month.

With women who have already shown a predisposition to abortion, and with neurotic and excitable subjects generally, special care should be taken to avoid all exciting causes, bodily or mental. The care should be greatest for the first four months, and especially at the first two or three menstrual epochs, at which times it is often prudent to keep the woman in bed for a few days. The exciting causes most to be guarded against are mental excitement or alarm and undue muscular exertion. In some cases even travelling and riding in a carriage have to be given up. Strong purgatives and the use of vaginal syringing either too vigorously or with too hot or cold water should also be avoided. Though it is not usual with the human race to give up coitus during pregnancy, some women who are especially prone to abort only go to the full term if they occupy a separate room from their husbands during pregnancy, or at any rate for the first four months.

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* The following formula may be used:—Liq. Hydrarg. Perchlor. ♏ lxxx.; Acidi Hydrochlor. dil. ♏ x.; Syrupi ʒj.; Aq. ad ℥j.; ter quotidie.

Treatment of threatened abortion.—So long as hæmorrhage is not very severe, while there is no proof of escape of the liquor amnii, and the cervix is not dilated so as to allow the ovum to be felt presenting, abortion may be regarded as only threatened and not inevitable, and an effort made to avert it. This is rarely, however, successful if both hæmorrhage and rhythmical pains are present; if only one of these symptoms exists, the attempt is much more hopeful. In all cases of threatened abortion the first necessity is to direct that the patient should be kept completely at rest in bed and that any solid substances passed should be saved for examination. If hæmorrhage is at all considerable the bed-pan should be used. The patient should not leave her bed, or be lifted up from the horizontal position for any purpose, and should avoid all movement as far as possible. Diet should be light. Alcohol and very hot or cold liquids should be avoided. If retroversion or retroflexion of the uterus is detected on vaginal examination the uterus should be restored, if possible, by gentle manipulation, in the manner previously described (see p. 346). In general it is better to wait till the symptoms have been quieted by rest and sedatives before introducing a pessary.

The drug most to be relied on to check the action of the uterus is opium. A subcutaneous injection of morphia may be given to start with; or Battley's liquor opii sedativus or nepenthe may be given in twenty minim doses for two or three doses, and afterwards in ten minim doses every four hours. If the abortion does not become inevitable, the opiate must be continued until all symptoms have completely subsided, and the patient should still be kept in bed for a week or ten days afterwards. Purgatives should be specially avoided, and the bowels should be relieved, if necessary, by enema; or, when symptoms are subsiding, by gentle laxatives. An American preparation, the liquid extract of Viburnum prunifolium, has been recommended as having a special influence in averting uterine contractions. It is given in drachm doses. Bromide of potassium is also sometimes useful in addition to opium, or when opium is not well tolerated. When hæmorrhage persists for many days or weeks consecutively without the occurrence of active contractions, and is sufficient in quantity to necessitate further treatment, ergot may be given in small doses, such as ten or fifteen minims of the liquid extract, in combination with opium. With this treatment there is a certain risk that the uterus may be excited to expel its contents, but frequently the ergot in such doses induces only gentle tonic contraction of the uterus. As the drug also tends to contract the arteries and diminish the force of the heart, it may then be successful in bringing about arrest of hæmorrhage without the occurrence of abortion.

Treatment of inevitable abortion.—Abortion may be regarded as inevitable, if the ovum is felt presenting through the dilated os, if the liquor amnii has, without doubt, escaped, or if the hæmorrhage is very excessive. If any considerable clots have been expelled through the cervix uteri, the abortion almost always proves inevitable, but the pregnancy has been known to continue notwithstanding. Assuming that the abortion is inevitable, it is to be remembered that the process is to a certain extent a natural one, resembling labour on a small scale, and that interference is necessary only when hæmorrhage is excessive, or the evacuation of the uterus incomplete. Within the first eight or ten weeks of pregnancy it is especially desirable to avoid premature or needless manipulation, since this is likely to lead to rupture of the ovum, which otherwise may be expelled intact. After the fourth month, also, the process of abortion approximates more and more to that of delivery; there may be little or no hæmorrhage before the birth of the fœtus, and, if so, no interference is required at that stage.

In the early months hæmorrhage is rarely very excessive, provided that the ovum is expelled entire, as the ovum itself, in such cases, forms a plug when pressed down into the cervix. The ovum need not then be removed by the finger unless the whole of it is felt as having descended into the vagina, or at any rate into the expanded cervix. If portions of the decidua vera remain attached to the uterine wall, after the expulsion of the intact ovum, they need not be sought for by the finger, but may be left to break up and come away in the discharges. When the liquor amnii escapes, especially in the third or fourth month of pregnancy, there may be considerable hæmorrhage either before or after the expulsion of the embryo. In this case the treatment to be adopted varies according to the condition of the cervix. If the cervix is undilated, and the ovum out of reach, the choice lies between plugging the vagina and plugging the cervix itself with a sponge tent, or with a laminaria or tupelo tent, adding a vaginal plug in addition. Plugging the vagina is generally preferable, since materials for the purpose are always at hand, and the risk attendant on the use of tents is thus avoided. The plug not only arrests the bleeding, if properly applied, but acts as a stimulus to uterine contraction, so that the ovum is often found lying behind it, when the plug is removed. The general principle is that the vaginal plug is correct treatment for serious uterine hæmorrhage in pregnancy, while the uterine cavity is not large enough to allow a dangerous amount of blood to be effused within it. It is therefore available in the earlier months of pregnancy, not at or near full term, except in the case of placenta prævia, and it is on no account to be thought of after delivery in the later months or at term.

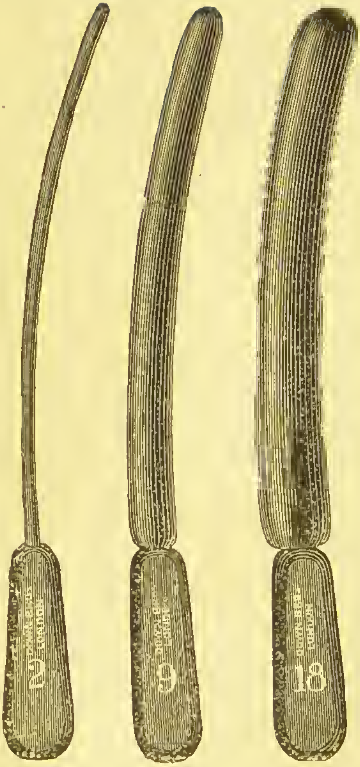

Fig. 147.—Hegar's dilators.

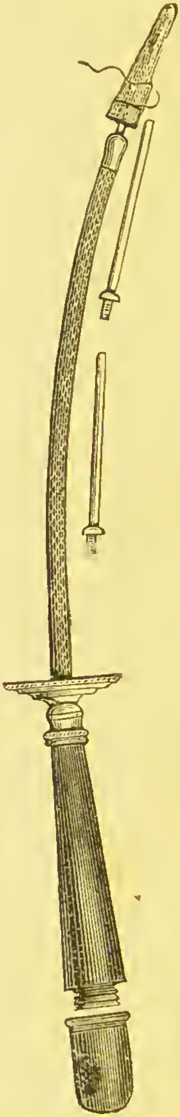

Fig. 148.—Barnes' tent introducer.

Method of plugging the vagina.—A vaginal douche should first be used with perchloride of mercury 1 in 2,000. A method of plugging often recommended is to use tampons of cotton, tied at intervals upon a tape. This is not a good plan, since the cotton is so compressible that the plug is apt to shrink and allow further bleeding. The safest material to use is iodoform gauze in long strips. In the absence of this rather broad strips of lint or linen about a foot long may be taken, and either moistened with some antiseptic such as carbolised oil, iodised glycerine, eucalyptic vaseline, or salicylic cream, or else dusted with iodoform. Strip after strip is then packed in through a Sim's speculum until the vagina is sufficiently distended. The tapes are left hanging out a few inches, and have one, two, three, &c., knots tied upon them, so as to indicate the proper order for withdrawal, the reverse of that of their introduction. The plug should not be left in more than about six hours, after which time it may be reapplied if necessary, and the vagina should be again irrigated with the antiseptic on its removal.

In conjunction with the use of a vaginal plug, a full dose of ergot may be given in a case of abortion with considerable hæmorrhage. The most effectual and rapid method is to give a subcutaneous injection of ergotin, passing the syringe deeply into the gluteal muscles. Failing this, one or two drachms of the liquid extract, or liquor secalis ammoniatus, may be given by mouth.

If the ovum is not expelled after two applications of the vaginal plug, nor the os sufficiently dilated to allow it to be extracted, the cervix should be dilated, either under anæsthesia with Hegar's dilators, or by means of a tent.

Method of using Hegar's dilators.—The vagina being first disinfected, the patient is placed on the left side, a Sim's speculum passed, and the cervix seized and drawn somewhat down by tenaculum forceps (Fig. 150, p. 412). A size of dilator (Fig. 147, p. 408), which will quite easily pass is first used. Then successive sizes are passed, up to about No. 20, when the cervix will be large enough to admit the finger. When there is much resistance, it may be necessary to spend one, two, or three minutes in the introduction of each.

Method of using tents.—Laminaria or tupelo tents are less likely to cause septic mischief than sponge tents, and are therefore generally preferable. A sponge tent, however, forms a more perfect plug to the cervix, and may be chosen if a patient is so blanched from hæmorrhage that it is very important to stop the slightest further loss. If used, it should be impregnated with iodoform dissolved in ether. Laminaria tents have the greater power, tupelo tents expand more quickly. Either may be smeared with salicylic cream* or iodoform and vaseline, and mounted upon a Barnes' tent introducer (Fig. 148, p. 408). The introducer with the tent may then be passed like the uterine sound, without the use of a speculum, the patient lying in the left lateral position ; or Sim's speculum may be used, the cervix being drawn forward and fixed, either by Sim's tenaculum hook (Fig. 149, p. 411), or by tenaculum forceps. In case of difficulty the latter method should be chosen. If the cervix is small, a single tent only is used ; if it is already somewhat dilated, several are placed side by side. The ends should project through the external os. In the present case, the vagina should be moderately plugged below the tents, to keep them in position, and aid in arresting hæmorrhage. Laminaria tents should not be left more than about eight hours. With sponge or tupelo tents three or four hours are sufficient. On their removal, the antiseptic douche should be again used. If dilatation is still insufficient, a second application is permissible ; but not more than two in succession for fear of septic absorption.

Method of evacuating the uterus.—If the os is dilated enough to allow the ovum to pass, or, in the case of an early abortion, to admit the finger, the uterus should be emptied at once, if the hæmorrhage is so considerable as to require interference. The manipulation now to be described is also to be carried out in precisely the same way, if there is occasion to remove the placenta after escape of the embryo. Unless pregnancy has been far advanced the index finger only is to be introduced into the uterus. The great principle to be followed is, if possible, to bring down the uterus within reach of the finger by external pressure rather than to force the finger up to the uterus. The first essential is that the bladder should be emptied, and it is generally well to make quite certain of this by passing the catheter. As much relaxation as possible of the abdominal muscles must be secured. For this purpose, the head should be supported by a low pillow only, the shoulders low, the thighs flexed, and, if necessary, the patient's attention should be distracted by conversation. The left hand is then pressed deeply into the abdomen, not too near the pubes, so as to get behind the uterus, and bring the fundus forward close behind the upper margin of the symphysis pubis (see Fig. 7, p. 12). If the uterus can once be got into this position, it is generally possible to evacuate it without introducing more than a single finger into the vagina, and to get the finger quite up to the fundus by the time that the evacuation is complete. In introducing the finger, the cervix is drawn somewhat forward by the tip of the finger hooked into it, while the fundus is pressed downward by the external hand.

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* Salicylic acid, 1 part ; vaseline, 8 parts.

If possible, the finger is passed behind and above the ovum or placenta, and rather toward its left-hand side if the right hand is used in the vagina. Conversely, if the left hand is used internally, the operator standing at the patient's left side, the finger is passed behind and to the right side. The flexor surface of the finger then sweeps the retained mass so far as possible as a whole downward into the vagina. If it is impossible at first to reach above the retained ovum, what is within reach may be removed first. Then the uterus contracts up, as it is emptied, with the aid of external pressure, and brings the remainder within reach. The finger should not be finally withdrawn until the cavity is to a great extent closed up, otherwise bleeding may occur, and clots be formed within it. In closing up, the cavity tends to resume the flattened form it has in the unimpregnated uterus. The right index finger, sweeping across from the left to the right cornu, can then finally make sure that nothing remains attached to its walls.

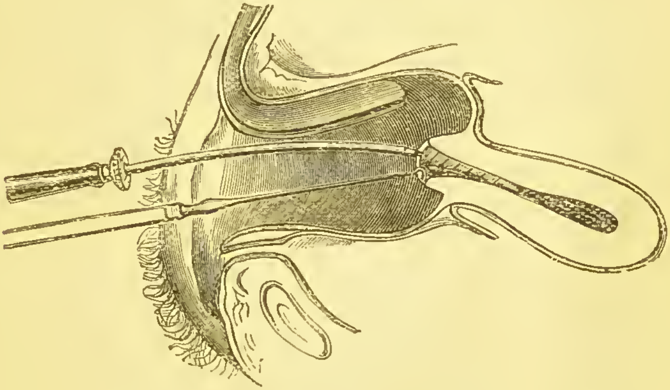

Fig. 149.—Mode of introducing a tent through Sim's speculum.

When the uterus has once fully retracted there is hardly ever any hæmorrhage beyond the ordinary discharge, analogous to the lochial discharge. It hardly ever happens, therefore, that any styptic is required to arrest bleeding. If contraction fails and serious bleeding does occur, a solution of perchloride of iron, either about 1 part in 8 of the solid salt, or 1 in 4 of the strong solution, may be used. This may be applied on a thickly wrapped Playfair's probe or sound passed as a swab by aid of Sim's speculum; or, if this fails, it may be injected by the hydrostatic method hereafter to be described (see p. 417). For a less severe degree of bleeding it is preferable to use Churchill's tincture of iodine. This generally stimulates the uterus to contract; it is also antiseptic, and does not leave any hard clots.

There are two causes which are apt to render it difficult to get the uterus into the requisite position—first, rigidity of the abdominal muscles, or thickness of abdominal walls; and, secondly, a more or less retroverted or retroflexed position of the uterus. The difficulty is greatest when the two are combined, for then the external hand cannot get behind the fundus without being pressed in very deeply, and this the abdominal walls will not allow. Several expedients may be used to overcome the difficulty. Rigidity of muscles is most completely overcome by an anæsthetic, and, if the rigidity is very great, or the patient very impatient of manipulation, it is desirable to administer one. When the muscles are once fully relaxed by this means, there is rarely any difficulty.

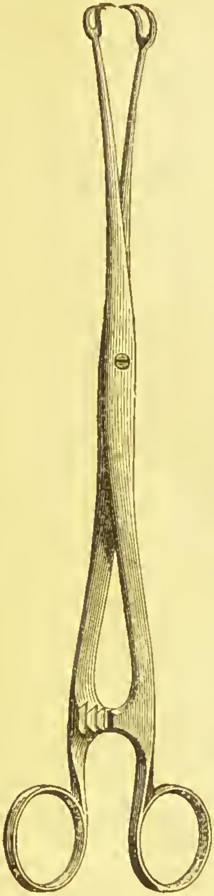

Fig. 150.—Uterine tenaculum forceps.

There are other means, however, which often suffice, without the use of an anæsthetic. If the woman has had children previously, it will frequently be possible to pass the half hand (excluding the thumb) or even the whole hand into the vagina. The index finger can then be passed into the cervix, and used like a repositor, as in restoration of the uterus by the sound, so as to bring the uterus forward into anteversion, and enable the external hand to command the fundus. If the half hand cannot be passed into the vagina, it may be possible, by the use of a tenaculum, such as that shown in Fig. 150, to get the index finger far enough into the cervix to act as a repositor. The tenaculum is fixed firmly into the anterior lip, and the cervix is drawn forward while the finger is passed into it. The tenaculum may then be given to an assistant, to keep up the traction, while the left hand is transferred to the abdomen, and the uterus brought into the position already described. It is better to make counter-pressure with the external hand, rather than counter-traction with the tenaculum, during the evacuation and passage of the finger up to the fundus, otherwise the cervix may possibly be lacerated by the tenaculum. When an offensive discharge is present, it is better, if possible, to avoid the use of the tenaculum, for fear that the punctures might afford a site for septic absorption.

Various ovum forceps have been devised to remove ovum or placenta, but the finger is a far better instrument than any. If the placenta is adherent, it has generally to be removed in pieces. Even though adherent or indurated, placental tissue is always soft enough to be gradually broken up and detached from the uterine wall by the pulp of the finger without use of the nail. As any piece is detached, it is hooked between the finger and the uterine wall, and drawn out of the uterus. The finger is then again introduced, and so on till the whole is removed. As the uterus is emptied, it generally contracts up upon the finger, diminishing its cavity, and so facilitating the evacuation. The operator should never desist until he has completely reached the fundus with his finger, and made sure that all placenta is removed, leaving nothing more than roughness, or slight shreds, at the placental site. For if some of the placenta is left, after entry of air has been facilitated by insertion of the finger, there may be more decomposition, and worse results than if no interference at all had been undertaken.

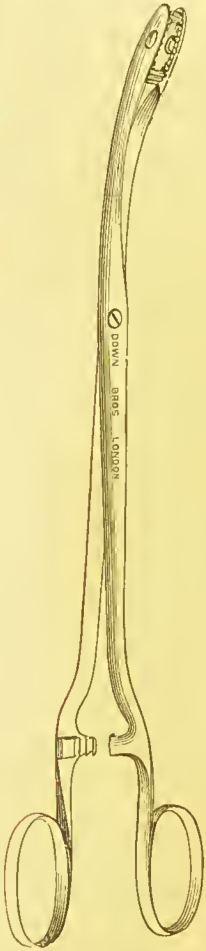

Fig. 151.—Ovum forceps.

The only use to which ovum forceps should ever be applied is to draw out of the uterus pieces which have already been detached or nearly detached, if this cannot be done easily by the finger alone. They are rarely required even for this, except in the case in which placenta has been allowed to be retained some time. The cervix may then have contracted up, so as barely to allow the finger to pass, while the body of the uterus remains comparatively large and globular. It is then difficult to hook a loose piece out of the wider cavity into the cervix already filled by the finger. The piece may then be grasped by forceps, guided up to it by the finger. Forceps for this purpose should be somewhat curved, to suit the genital canal; the blades should be not more than half an inch wide, and should have transverse ridges, interlocking with each other, so as to give a firm grasp (see Fig. 151).

Treatment of incomplete abortion.—If the fœtus has escaped and the placenta, or incipient placenta, remains behind, it is of the greatest importance to effect an early and complete evacuation of the uterus. Though this principle is generally accepted by all good authorities, it is not yet universally carried out in practice. Digital extraction of the placenta is necessarily unpleasant to the patient; and, if she is intolerant of manipulation, and reluctant to take an anæsthetic, there is a temptation to leave the case to nature—at any rate, until decomposition occurs, or constitutional disturbance arises. It is true that the patient generally recovers, if this practice be adopted, and that the placenta is generally expelled after a few days. The disadvantages, however, are many. There is some risk of even fatal septicæmia. The placenta, if adherent, is generally not expelled till softening by decomposition has begun, and fragments of it are apt even then to be retained, and to cause persistent or recurrent hæmorrhage. The patient generally goes through a stage of febrile disturbance, due to some degree of septic absorption, and often accompanied by some metritis, pelvic peritonitis, or cellulitis. As a result of this, the natural involution of the uterus is retarded by the active hyperæmia kept up by the inflammation, and chronic uterine trouble is apt to remain afterwards.

The length of time for which the placenta may be left must depend upon the circumstances of the case. If the patient is tolerant, and the uterus can be easily cleared out without an anæsthetic, it is well not to wait more than an hour after the passage of the fœtus. The cervix is then sure to be large enough to let the finger pass easily, whereas later on it may have closed up again more or less. If an anæsthetic is required, there should be an assistant to administer it; for the operation must be carried out very deliberately and carefully, and an imperfect evacuation is often worse than no interference at all. Meanwhile the placenta should not be allowed to remain more than about twelve, or, at the outside, twenty-four hours. If the assistance of an expert in obstetrics is available for the operation, it is often of advantage. If there is hæmorrhage, the vagina may be plugged meanwhile, care being taken either to use iodoform gauze or to moisten the strips of lint with some antiseptic (see p. 409), such as carbolic oil, iodised glycerine, or eucalyptic vaseline, and not to leave the plug more than twelve hours at the utmost. On removal the placenta will sometimes be found lying above the plug. The less the hæmorrhage, the greater is the probability that the placenta is firmly adherent, and not likely to be expelled by nature. The operation is to be carried out according to the method already described (see pp. 410—413).

It may happen that the case is only seen at a later stage, when the placenta has been already retained for days, or when doubt exists whether it has come away or not. Or again, hæmorrhage may be persisting or recurrent at a considerable interval, even for weeks, after the commencement of the abortion. The presence of an offensive discharge, or the large size of the body of the uterus felt bimanually, will be a sign that the uterus is certainly not emptied. In any case the principle of treatment is the same as in the former instance, namely, to explore completely the uterine cavity up to the fundus, and make sure that it is entirely emptied. The course of action to be adopted will depend upon the condition of the cervix. If any considerable portion of the placenta remains, especially when there is enough to cause an offensive discharge, the cervix will generally remain open enough to allow the finger to be passed through with steady pressure, an anæsthetic being given if required. If the cervix has closed up too much for this, as is often the case if only minute fragments of placenta remain, or if the hæmorrhage is due not to retained placenta, but to a granular or villous condition of the uterine mucous membrane remaining after the abortion, it must first be dilated. This is a case in which rapid dilatation with Hegar's dilators, or some other mechanical dilator, has a decided advantage over the use of tents, as involving less risk of septic absorption, especially if there is already any offensive discharge or febrile disturbance. The method of using Hegar's dilators has been already described (see p. 409). If a tent is used at all, it should be laminaria or tupelo.

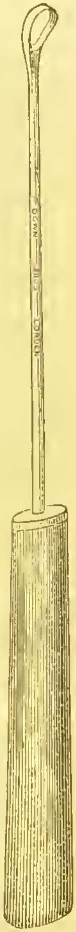
Fig. 152.—Blunt curette

If any adherent placenta is found, the finger will generally suffice to detach it. If no placenta is found, but only a roughened, softened, or villous condition of mucous membrane as a source of hæmorrhage, the surface should be scraped with Thomas's blunt curette (Fig. 152). This will also remove any small fragments of ovum or decidua which may remain adherent. The instrument is shaped like Sim's sharp steel curette, but consists only of a loop of soft copper wire. It therefore scrapes away little or nothing from a normal uterine mucous membrane, but breaks down and removes any softened or elevated portions. The blunt curette may be used either with the aid of Sim's speculum, or without any speculum. The stem of the curette, being itself of copper, may be bent to suit the curve of the genital canal, the curve being reversed for scraping the posterior wall of the uterus.

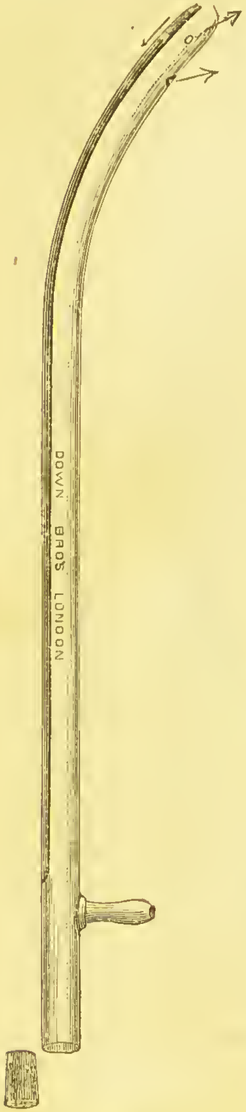

Fig. 153.—Budin's double-action catheter.

If severe febrile symptoms arise within a few days after an abortion, and there is not evidence that the uterus has been completely emptied, it may be presumed that there is septic absorption from some portion of ovum retained in the uterine cavity. There will sometimes be an offensive discharge to indicate this, but not always. There may be decomposing matter in the uterus, and no indication of it in the vagina, especially if vaginal syringing has been employed. The uterus should be explored and emptied as early as possible after the outset of the septic symptoms, the use of a tent being avoided if possible. If the patient is seen only at a late stage, if there is a local swelling of pelvic cellulitis or peritonitis to account for the febrile attack, and it is thought that the decomposing material has come away, it may be desirable not to interfere actively. In case of doubt, the blunt curette may be used for diagnosis, to decide whether any pieces of ovum still remain.

If the contents of the uterus have been found offensive, the interior should be washed out with an antiseptic. A solution of perchloride of mercury (1 in 2000) is the most effective, and may be afterwards washed away with a weaker solution, such as 1 in 4000. The safest method is to attach a glass funnel by an elastic tube about three feet long to a Budin's catheter (Fig. 153). This is the best form of double action catheter, the section of the tube being in the form of a horse-shoe, so that a deep groove is formed outside the tube for the return current. This is less likely to be blocked by clots or shreds than a return tube. This form of catheter is made in various sizes, both in celluloid and in glass, as shown in the figure. In the instrument shown, the elastic tube conveying the fluid is attached to the projection at the side, and the end stopped by the cork. The opening at the end is intended for washing out the tube. A large elastic tube is placed over it, and attached to a tap, so that a strong stream of water may be passed through the tube. In the absence of a Budin's catheter, a gum elastic catheter, not large enough to fill up the canal of the cervix, may be used. The uterus is then washed out by hydrostatic pressure, care being taken to avoid the entry of air by filling the tube and catheter, and placing a clip upon the former, before introducing the catheter into the uterus. Even in the absence of anything positively offensive, it may be advisable to swab out the uterine cavity with an antiseptic, which has also a styptic effect. A Playfair's probe should be wrapped rather thickly in absorbent cotton, dipped in tincture of iodine, and passed up to the fundus uteri, with the aid of a Sim's speculum. This application generally excites also contractions of the uterus. If there has been hæmorrhage, and only soft granulations of mucous membrane are discovered, swabbing with Churchill's tincture of iodine * is desirable, in order to alter the character of the mucous membrane.

The so-called placental or fibrinous polypus (see p. 402) may offer some obstacle to detachment by the finger, if the pedicle is small on account of its slippery character. In some cases an ecraseur has been used for its removal, but this will hardly ever be necessary, if the finger is adjusted exactly above the point of attachment, and the whole mass pressed firmly downwards.

Treatment of abortion in the later months.—In the fifth and sixth months interference for arrest of hæmorrhage is much more rarely required before the birth of the fœtus. After delivery, contraction of the uterus must be secured, as in labour at term, by external pressure, as a safeguard against hæmorrhage. An attempt may be made to effect the expulsion of the placenta by the method of expression (see p. 219). Failing this, it will generally be necessary for its removal, to introduce the half or whole hand into the vagina, and two fingers or the half hand into the uterus. If the placenta is attached on the right side of the uterus, it is most easy to detach it by introducing the right hand, and conversely, so that the tips of the fingers may detach the upper border of the placenta first.

After-treatment.—Patients are commonly inclined to make too light of an abortion, and to get about too soon. This is one of the reasons why chronic uterine disease is so often a sequel. As a rule confinement to bed as long as after labour at term, or at any rate until all sanguineous discharge has ceased, is desirable. After a severe abortion in the third or fourth month with difficult extraction of the placenta, more prolonged rest still is often called for. Care should be maintained for some weeks more, with a view to the subinvolution of the uterus which is apt to remain. Involution may be assisted by a course for some weeks of the liquid extract of ergot in half-drachm doses, or two or three grains of ergotin in pill three times a day. A grain or two of sulphate of quinine may often be added with advantage, or iron if there is anæmia after hæmorrhage.

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* Iodine, 75 grains; iodide of potassium, 30 grains; rectified spirit, 1 ounce.

CHAPTER XXV.

HÆMORRHAGE IN PREGNANCY.

THE consideration of hæmorrhage in the earlier months of pregnancy resolves itself almost entirely into the consideration of threatened abortion, which has already been discussed. For the causes tending to hæmorrhage tend also to excite premature expulsion of the ovum; and the hæmorrhage itself, by separating the placenta, or leading to the formation of clots which irritate the uterus, increases this tendency. Placenta prævia, so important a cause of hæmorrhage toward the end of pregnancy, may also be a cause of it in the months which follow the differentiation of the placenta. No doubt even before this, an incorrect implantation of the ovum may have the same effect, though such a cause will generally escape recognition. Placenta prævia is, however, only the cause of a relatively small proportion of the cases of hæmorrhage occurring in the early and middle months. In persistent or recurrent hæmorrhage in the fourth or fifth month, without obvious exciting cause of abortion, placenta prævia is not found in more than one-fifth of the cases.

Menstruation in pregnancy.—That the menstrual nisus does to a certain degree persist during pregnancy, is shown by the special liability to abortion at what would have been menstrual periods, as well as by the presumed onset of labour at the tenth epoch after the last menstruation. Ovulation, however, during pregnancy is an occurrence of extreme rarity (see p. 264). It is probable that in many cases in which women themselves give a history of menstruation in pregnancy, the bleeding has not been sufficiently regular in its occurrence to entitle it to this description, but has been really a bleeding indicating a threatened abortion. Menstruation in pregnancy is occasionally met with, but is extremely rare, so that, in any case of doubtful pregnancy, the persistence of menstruation, however scanty, is a strong presumption against pregnancy existing. The occurrence of one menstruation, or apparent menstruation, after conception, is not, however, so very uncommon. It is much more rare for it to be repeated two, three, four, or five times, and still far more so for it to continue up to, or nearly up to, full term.

Up to the fourth month there is a decidual cavity, between the decidua vera and reflexa, and it is therefore possible for menstruation to take place from the surface of the mucous membrane. It is not positively known whether in the menstruation of pregnancy any exfoliation of the surface takes place, as in ordinary menstruation, but this can hardly occur to any extent without involving also the separation of the decidua serotina.

Women who menstruate in pregnancy rarely have a perfectly healthy uterus. Sometimes they have suffered previously from menorrhagia. Frequently they are multiparæ, and have erosion or granular inflammation of the cervix from the effect of previous parturition. It is believed that, in many cases, this inflamed cervix is the site of the bleeding. If the blood comes from the body of the uterus, probably exfoliation or rupture of superficial vessels is only partial. After the fourth month, if menstruation continues, either the blood must come from the cervix, or there must be, in fact, a threatening of abortion at each month. A double uterus has not been found to exist in recorded cases of menstruation in the later months, and would not account for the occurrence if it did exist, for the decidua formed in the unimpregnated side is generally retained until after parturition. Menstruation in pregnancy must therefore be regarded as a morbid occurrence, and women who so menstruate should take special care to rest at the periods, as being liable to the risk of abortion.

Hæmorrhage in the later Months of Pregnancy, Placenta Prævia, Accidental Hæmorrhage.

It has been usual to divide hæmorrhage in the later months of pregnancy, and before parturition, into two classes, "unavoidable hæmorrhage," that is, hæmorrhage due to placenta prævia, or implantation of the placenta so low down in the uterus that it must become detached in the dilatation of the cervix, and "accidental hæmorrhage," or hæmorrhage due to partial separation of a normally situated placenta.

Placenta Prævia.

Definition.—In placenta prævia, the placenta, instead of being attached near the fundus, is situated low down in the body of the uterus, either overlapping or approximating to the internal os, so that a part of its insertion is on the lower segment of the uterine body which has to be stretched to allow the fœtus to pass. In Fig. 154, it is evident that dilatation of the os to the size indicated by the dotted lines inevitably detaches the lower part of the placenta. When it was believed, as formerly, that a large part of the cavity of the cervix was taken up into the cavity of the body of the uterus with the advance of pregnancy, it was thought that the placenta might be attached to the internal surface of the cervix. The phrase which has more recently been used of attachment of the placenta to the "cervical zone" of the uterus has also led sometimes to misconception. It must be clearly borne in mind, therefore, that only the body of the uterus can give attachment to the ovum, and that the mucous membrane of the cervix is not adapted to this purpose. Although the theory of the expansion of the upper part of the cervix

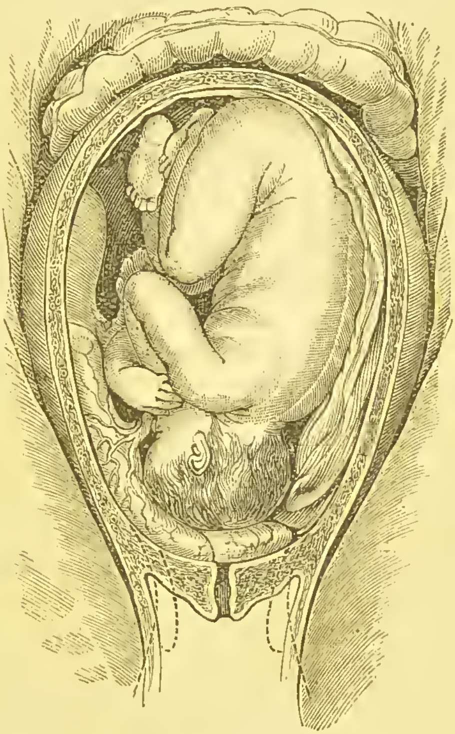

Fig. 154.—Placenta prævia. Two varieties of insertion are indicated; one in which the placenta overlaps considerably the internal os, and would appear as a complete placenta prævia when the os was partially dilated; one in which it is attached just short of the internal os, and would appear as partial placenta prævia, when the os was partially dilated.

has again been revived of late (see p. 107), there is no doubt that, in placenta prævia at any rate, the internal os remains undilated up to the time at which hæmorrhage first occurs.

Varieties.—It has been usual to divide placenta prævia into three varieties, complete, or central, when the whole of the os is covered by placenta; partial, when it is only partially covered; and marginal, when the placenta just reaches the edge of the os. The true view of the relation of placenta prævia to the internal os being adopted, these varieties have no longer any strict accuracy. While the internal os is undilated, the placenta will either overlap the os or not in almost all cases, while the probability against its situation being exactly central must be very great indeed. The varieties are still retained, but are judged of according to the relation of the placenta to the internal os when an examination is made, partial dilatation of the os having taken place. The classification of any given case may therefore vary according to the stage of dilatation reached. Many cases in which the placenta overlapped the undilated os will appear as cases of only partial placenta prævia at the later stage; and many again in which it only approached the os and did not overlap it at all will likewise appear, at the same stage, as cases of partial placenta prævia, only somewhat less in degree. Further, the edge of the placenta may reach within the zone of necessary detachment, and yet never overlap the internal os at all even when dilated. In such case the placenta would be detected only if the finger were passed within the uterus. It is only when the placenta approximates more or less toward a central position that it continues to appear as a complete placenta prævia throughout the whole dilatation stage.

Causation.—Placenta prævia is very rare in primiparæ, and is relatively common in women who have had a large number of children. It may be inferred that it depends upon some morbid condition of the uterus previous to conception, and this conclusion is often confirmed by the previous history of patients in whom this condition is found. It is probable that the chief element in causation is a dilation of the cavity of the uterus, due to subinvolution, hypertrophy, or endometritis. The effect of this is likely to be that the ovum, instead of being arrested at once by the mucous membrane nearly filling up the cavity when it reaches the uterus from the Fallopian tube, is liable to fall down to a lower part of the uterus before it becomes attached. It is possible also that a morbid state of the mucous membrane itself, rendering immediate adhesion of the ovum less easy, may have some influence in the matter. A placenta prævia is often found thinner and more widespread than usual. The explanation may be either that a more extended placenta has a greater chance of overlapping the zone of detachment, or that the lower segment of the uterus being less adapted for supplying nourishment to the placenta, the placenta has become extended as a compensation. The latter principle holds true to some extent at any rate, for there is generally a special thinness around the position of the internal os, if this is at all near to the edge of the placenta.

Frequency.—The frequency of placenta prævia has been variously estimated at from 1 in 573 (Johnson and Sinclair: Dublin) to 1 in 1564 deliveries (Schwarz: Germany). In the Guy's Hospital Lying-in Charity, in 49,145 deliveries, the proportion was 1 in 534. Only about 4·4 per cent. were primiparæ.

Pathological Anatomy.—The lower segment of the uterus may be regarded as nearly equivalent to a hemisphere in shape, the undilated internal os being at the centre of the curved surface. In its dilatation for the passage of the child this hemisphere has to be converted into a cylinder equal in capacity to the circumference of the hemisphere. Hence each ring of the hemisphere has to be stretched, the stretching rapidly increasing in degree as the os is approached. It is therefore easy to understand that, when the attachment of the placenta overlaps any ring of the uterus which is stretched at all considerably, the placenta cannot follow the stretching but becomes detached, and so causes inevitable hæmorrhage in the first stage of labour. If the fœtal head, as presented to the genital canal, be taken as about 3½ inches in average diameter, and the lower segment of the uterus therefore compared to a hemisphere having the same diameter, it will be found the zone of the uterus liable to stretching extends about 2½ inches from the original position of the internal os, the distance being measured from the os along the chord, or nearly 3 inches, if measured along the arc. There is a narrow zone, at the upper part of this dilatable zone, in which the stretching is only slight, and the placenta may be able to yield to it without detachment. Any slight degree however of those causes liable to cause detachment of a normally situated placenta, such as shocks or blows, will be apt, during the first stage of labour, to cause detachment and bleeding very easily, the placenta being already on the strain. Speaking roughly, it may be estimated that a zone reaching to about two inches from the undilated internal os, measuring along the arc, is the zone of necessary detachment, and that above this there is another zone measuring about an inch or a little more in width, which is the zone of possible detachment, or dangerous insertion. If the placental attachment overlaps the first zone, hæmorrhage in labour is unavoidable; if it overlaps only the second, hæmorrhage may occur from slight causes. Above these zones is the area of safe attachment, so far as concerns the effect of dilatation.

Source of the blood.—The blood comes mainly from the arteries and veins in the uterine wall separated from the placenta, but to some extent also from the separated placental surface, especially from the margin which, at any moment, has just been separated. It might perhaps have been expected that the blood, constantly entering the maternal blood-spaces which permeate the whole placenta, would continuously pour out through the open mouths of the vessels on the separated surface. Sir James Simpson indeed maintained that this was the main source of bleeding. Any such continuous loss from the placenta is however prevented by thrombosis taking place in the detached portion. Arterial bleeding from the uterine wall is, to a certain extent, kept in check by that very stretching of the uterine wall which separates the placenta. A patient therefore hardly ever bleeds to death with the rapidity sometimes seen in bleeding from the placental site in post-partum hæmorrhage.

Cause of bleeding before full term.—The cause of the unavoidable hæmorrhage in the first stage of labour is obvious enough, but there have been various theories to account for the hæmorrhage often beginning in pregnancy, especially during the last two or three months. When it was believed that the cervix was taken up into the cavity of the uterus in the course of pregnancy, such expansion of the cervix from above was believed to separate the placenta; but then there was no explanation why the hæmorrhage did not always begin before labour. Barnes has supposed that detachment is caused by excess of the growth of the placenta over that of the corresponding part of the lower uterine segment, which is not adapted for its attachment. Matthew Duncan has supposed that the causes are similar to those of accidental hæmorrhage, only that they act with greater facility when the placenta is prævia. The real main reason appears to be that, although the cervix is not usually taken up into the cavity of the uterus long before the onset of labour, yet a slight temporary or permanent dilatation of the internal os is very common in the last two months of pregnancy. It is probably due to the occasional uterine contractions which do not cause any feeling of pain (see p. 123). Thus, in multiparæ, it is not uncommon, in the last month or two, to be able to pass the finger through the internal os, and feel the head presenting. And any, even the slightest, commencement of such dilatation of the small internal os must cause detachment of the placenta at its edges, when it overlaps the internal os. Again, it is probable that the placenta when attached over the internal os is more liable to detachment from coitus or other mechanical causes than when normally situated. For shocks and jars are communicated more directly to the pelvis than to the fundus of the pregnant uterus, and, moreover, in the upright position of the woman intra-vascular pressure is greater at the placenta when this is prævia. In this case the hæmorrhage would be truly analogous to "accidental hæmorrhage," only produced with greater facility.

Besides its frequent thinness in the vicinity of the os, the placenta often shows old thrombosis in the part abnormally situated, if there has been partial detachment some time before labour, and consequent degeneration of the villi. The lower segment of the uterus is thicker than usual in consequence of the increased blood supply attracted to it through the placental attachment. This extra thickness sometimes offers an impediment to the easy dilatation of the cervix. Thus some of the most remarkable cases of the so-called "trismus" of the uterus, or spasmodic rigidity of the cervix, forming a grave obstacle to delivery, have been cases of placenta prævia.

Presentation of fœtus.—In placenta prævia the frequency of abnormal presentation is very much greater than the average. According to Müller's statistics* the proportion of vertex presentation is only 67 per cent. instead of nearly 97 per cent., the normal proportion; while pelvic presentations form 9·3 per cent. (compared with the normal 2·4 per cent.), and shoulder or transverse presentations, 23 per cent. (compared with the normal 0·4 per cent.). This result is partly due to the frequency of premature labour, but it appears to show that placenta prævia forms an obstacle to the axis of the child lying in the axis of the uterus. The bulk of the placenta itself, which prevents the head lying so low in the pelvis in the lower segment of the uterus, is probably the principal cause, and it may be that a greater relative expansion of the lower segment of the uterus has also some influence. Prolapse of the funis is also relatively much more frequent in placenta prævia, as might be expected from the greater vicinity to the os uteri of its outer attachment.

Symptoms and course.—Although placenta prævia may be a cause of abortion in the early months, yet cases positively recognized as of this nature commonly cause symptoms only within the last three months of pregnancy. The characteristic symptom is sudden and unexpected bleeding from the uterus, without adequate cause. Sometimes it is induced by moderate exertion, such as standing or walking, but it may come on when the patient is in bed or asleep. The cases of early hæmorrhage (seventh or eighth month) are generally those in which the placenta overlaps the undilated internal os. If the margin of the placenta reaches, or is in the close vicinity of the os, bleeding may begin rather later; if the placental attachment only encroaches moderately upon the zone of unavoidable detachment, bleeding generally only begins either with the stage of painless dilatation of the internal os premonitory of labour, or after manifest labour pains have begun. The first bleeding may be so violent as to cause extreme anæmia, and even quickly cause death. This is more apt to be the case when it occurs at or near full term. The bleeding which occurs earlier in pregnancy, unaccompanied by any pain, is generally not so severe at first, and may cease after a short time. It recurs from time to time, either on slight exertion or without any cause, and, when the first stage of labour begins, it is apt to be very copious. Premature labour often comes on, either after the first, or, more frequently, with subsequent hæmorrhages. In other cases there is no such violent hæmorrhage, but continuous oozing goes on for days or weeks.

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* Placenta prævia. Stuttgart, 1877.

If left to nature, the case may end in death from hæmorrhage before delivery. If, however, the uterus acts vigorously, a natural limit is put to the bleeding, especially when the dilated os is only partially covered by placenta, so that there is no obstacle to the rapid descent of the fœtus. The advancing head presses the placenta firmly against the uterine wall, and thus forms a plug. The tendency to hæmorrhage is less when once the placenta is separated so far as separation is inevitable, but it may still go on from the placental site, if the uterus is not active enough to cause pressure upon this. If the attachment is nearly central, the placenta may be detached entirely by uterine action and expelled before the fœtus. The result may be favourable, if the uterus is acting strongly; and the child even has been born alive. In the Guy's Hospital Lying-in Charity, however, the two cases of placenta prævia in which this incident occurred were both fatal through hæmorrhage.

Rare cases of placenta prævia are observed in which hardly any appreciable hæmorrhage occurs throughout the entire course. These are cases in which the separation only begins with labour, and in which the uterus is active throughout. Other rare cases again have been recorded, in which there is absolutely no hæmorrhage at the time of labour itself. In these instances, the placenta must have been separated at an earlier period so far as needful, and thrombosis have taken place in the vessels.

The labour pains in placenta prævia are frequently feeble, partly, in many cases, from the labour being premature, partly from the patient's exhaustion through the hæmorrhage. As already mentioned, the cervix uteri sometimes proves unusually rigid, notwithstanding the tendency of the hæmorrhage to relax it. Post-partum hæmorrhage also is liable to occur, probably in consequence of the same condition of exhaustion, and soon tells seriously on the already anæmic patient.

Diagnosis.—In the last three months, and especially within the last two months of pregnancy, placenta prævia is always the most probable explanation, if sudden and considerable hæmorrhage comes on without sufficient exciting cause, especially in the absence of pain, and the probability is increased if similar attacks of hæmorrhage are repeated. On vaginal examination, if hæmorrhage has been only slight or moderate, the internal os may not be permeable to the finger. There is then no absolutely certain means of physical diagnosis, but the uterus round the cervix may feel unduly thick, and the hard outline of the head will not be tangible through it, nor will ballottement be obtainable, at any rate where placenta is situated. There is no certainty in any auscultatory signs, such as finding the uterine souffle lower down in the groins than usual. Vaginal stethoscopy has been proposed, but could only be of use to those who had practised it much in normal cases. If hæmorrhage is very considerable, the internal os will probably allow the finger to pass on a little pressure, even if not already more dilated. If the os lies high up, the half hand, or if necessary the whole hand, should be passed into the vagina in order to assure the diagnosis. When the finger can once be passed through the cervix diagnosis is easy. The spongy mass of the placenta could only be mistaken for clot. Clot is easily removable by the finger, is less firm and spongy, while the placenta will be found continuous with the membranes if these can be reached. It must be remembered that, if only just overlapping the original internal os, the edge of the placenta is often much thinner and more membranous than usual. Unless the insertion is very nearly central, it will generally not be difficult, passing the hand into the vagina, to reach the edge of the placenta in some direction, find there the membranes, and through them make out what the presentation of the fœtus is. If the membranes cannot at first be reached, the direction of the nearest edge of the placenta will generally be indicated either by that part of the placenta which is thinnest, or by that which is most separated.

Prognosis.—Placenta prævia is one of the gravest complications of the puerperal state for the mother, and the prognosis is still graver for the child. For the mother, besides the immediate risk of hæmorrhage, there is that of septicæmia after labour. This is due partly to the increased tendency to absorption from emptiness of the vessels, partly to the low position of the placental site, more exposed to the lochial discharge flowing over it, partly to the

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manual interference and manipulation of the placental site which may have been found necessary. For the child the main danger is that of asphyxia from loss of maternal blood and separation of a great part of placenta. There is also often that of immaturity, or malposition, or the increased risk involved by version. The mortality to the mothers, including that of the puerperal state, has been variously estimated, by recent authors, at from 9 to 30 or 40 per cent. In the Guy's Hospital Charity it was 16·1 per cent. The mortality to the children is from 60 to 75 per cent., and a considerable portion of those born alive die within a few days. It is readily understood that the result to the mother depends largely upon the skilfulness of the treatment, and the speed with which medical assistance is obtained. The danger is greater the earlier the bleeding commences, the less it is accompanied by uterine action, the more nearly central is the placental insertion, and the greater the anæmia which is brought about before actual labour.

Treatment.—A patient having placenta prævia is never safe until delivery is completed; and the chief danger is that of violent hæmorrhage occurring in the absence of medical assistance. The general principles of treatment are to bring on labour quickly, to shorten the process of delivery so far as this can be done without any forcible interference, which would incur the risk of laceration or bruising, and meanwhile to limit the amount of hæmorrhage by securing some form of pressure upon the placental site.

Induction of labour.—As a rule it is desirable to induce labour as soon as a positive diagnosis can be made, or in any case in which hæmorrhage is very considerable, whether coming from an abnormally or normally situated placenta. The only exception to this is the case when pregnancy has not reached the seventh month, when hæmorrhage is not excessive, and when medical assistance can be obtained at short notice. It may then be desirable to attempt to prolong the pregnancy up to seven months in the interest of the child, if there is anxiety to save it. It is to be remembered, however, that the chance of this is somewhat remote in a case in which hæmorrhage begins so early, since the placenta then probably overlaps the internal os. If it be decided to temporize, the patient should be kept completely in bed, and opium or morphia administered so long as any bleeding occurs. A nurse may be instructed to plug the vagina in case of any sudden bleeding.

If it be decided to induce labour, the cervix not being yet permeable to the finger, a hot vaginal douche may first be employed, and then one or more tupelo tents placed in the cervix, and the vagina plugged beneath them in the manner already described (see p. 409). In three or four hours tents and plugs should be removed, and the vaginal douche used with perchloride of mercury 1 in 2000. If the cervix is not yet permeable to two fingers, it will probably be possible to introduce the smallest hydrostatic dilator, and so continue the dilatation.

Plugging the vagina and cervix.—If, at the onset of hæmorrhage, the cervix is found too small to admit the finger to make a positive diagnosis, or if, while allowing the placenta to be felt, it is still too small to allow two fingers to pass, plugging the vagina is a valuable resource, and one which can always be carried out with the materials at hand. It is considered permissible in placenta prævia, and not in accidental hæmorrhage, from the idea that in the former case the plug actually compresses the bleeding site. It is doubtful whether much pressure is really so exercised, considering that the internal os rapidly ascends to a considerable distance above the external, and that the placental site is above the internal os. Probably the most valuable effect is that of stimulating the uterine contractions by reflex action. The plugging should be carried out as already described (see p. 409), if possible with iodoform gauze, introduced with the aid of Sim's speculum. The plug should not be left more than about four hours. For if clots are allowed to remain and become decomposed above the plug, symptoms of septic absorption may commence even before delivery, and end in puerperal septicæmia afterwards. Some recommend, instead of the vaginal plug, the use in the vagina of an india-rubber dilator, distended so as to fill the canal. This excites uterine action on the same principle as the " colpeurynter," a hydrostatic vaginal dilator, used in Germany for the induction of labour. An air-ball vaginal pessary inflated by a small air-pump may be made available for the purpose. It requires, however, more careful watching than the vaginal plug, to make sure that it does not get displaced, and that it sufficiently distends the vagina. If it does so, it is a more powerful stimulus to the uterus than the ordinary vaginal plug.

Use of hydrostatic dilators.—If a hydrostatic dilator can be introduced into the cervix, it is preferable to a vaginal plug, for it dilates the cervix more rapidly, and stimulates uterine action more powerfully. It will often be possible to introduce the smallest size when the cervix admits one finger, if the improved form of Barnes' dilator, described in Chapter XXVII., be used. The cervix will then probably be dilated enough within an hour to allow of bipolar version. Champetier de Ribes' dilating bag may also be used, and, from its large size, will form a still more efficient hæmostatic, by compressing the placenta. But, for the introduction of this, the os must be large enough to admit two fingers, and the labour therefore advanced enough for bipolar version.

Hydrostatic dilators are also useful when the membranes are already ruptured and hæmorrhage continues, in order to secure a sufficient dilatation of the cervix to allow internal version or the application of forceps.

Digital separation of placenta.—If the placenta remains partially attached round the whole circuit of the os, the process of dilatation is retarded by the attachment. The total amount of hæmorrhage also appears to be less when the detachment is rapid, than when it takes place slowly in successive portions, for thrombosis quickly occurs in the part which has been separated. There is often an advantage, therefore, in aiding the detachment by sweeping round the finger inside the os. On the other hand, if more of the placenta is thus detached than need eventually be separated, it is obvious that not only is the chance for the child's life diminished, but that there is a risk of causing increased hæmorrhage. It is better, therefore, to make out in which direction the placenta is already most detached, and complete the separation on this side only, for about half the circle of the os, leaving attached the other part of the placenta, which will probably be its central portion. The manipulation is carried out by passing through the internal os the two terminal joints of the index finger and sweeping them round. For this purpose it may be necessary to introduce the whole hand into the vagina. The stage at which this proceeding is useful is when the cervix admits one finger only, and it may be adopted as a preliminary to plugging the vagina. R. Barnes recommends passing one or two fingers as far as they will go through the os uteri, and sweeping them round in a complete circle, but this seems to involve the detachment of more placenta than necessary.

Performance of version.—The traditional treatment for placenta prævia is the performance of version; and the discovery of the method of bipolar version rendered it possible to adopt this treatment at an earlier stage than formerly, namely, as soon as the cervix will admit two fingers. The majority of cases of placenta prævia in the Guy's Hospital Lying-in Charity have been treated in this manner since the introduction by Dr. Braxton Hicks of the new method of version. Of late this plan of treatment has attracted more attention, having been praised by German authorities as a novelty. In the majority of cases of placenta prævia bipolar version is available when the patient is first seen.

The performance of version is by far the most effectual means of arresting hæmorrhage in placenta prævia. When one leg is brought down the half breech forms a plug in the lower segment of the uterus, and presses the placenta against the uterine wall, so that there is hardly ever any hæmorrhage of consequence afterwards.

There is no necessity to hasten delivery by any forcible traction of the leg, a proceeding which might cause laceration of the cervix and subsequent septic absorption.

The method of performing bipolar version will be described in Chapter XXXIV. In this case, if the os is wholly covered by placenta, the hand is passed up, on the side where separation is greatest, between the placenta and the uterine wall till the membranes are reached. In the case of a very central placental insertion, it may be necessary, before performing the actual version, to rupture the membranes along the edge of the placenta, to draw that edge down towards the centre of the os, and then proceed with the version as rapidly as possible. If the cervix is already dilated enough to allow the whole hand to pass, the operator may turn by the internal method if he finds it easier.

Version should be performed in all cases of complete placenta prævia, and in cases even of partial placenta prævia if hæmorrhage is serious. The more placenta there is over the os, and the less active the uterus, the greater is the indication for version. If version is likely to be called for, it is better not to puncture the membranes till the operator is ready to perform it, because otherwise it probably cannot afterwards be carried out by the bipolar method.

Rupture of the membranes.—This method is applicable to cases of partial placenta prævia, especially those in which hæmorrhage is not great, and active labour pains have already commenced. It may be adopted more safely when dilatation of the os has made some progress, so that it may be followed up soon, if necessary, either by the application of forceps, or version by the internal method. In suitable cases it has the advantage that the chance for the child's life is greater than if version is performed. The uterus may act vigorously as soon as the liquor amnii has escaped, press the placenta against its wall, and rapidly complete delivery, or, if it does not, forceps may be applied.

Application of forceps.—If the membranes have been ruptured, if the os is sufficiently dilated, the placenta not too much in the way, if labour is not progressing fast, and some hæmorrhage continues, the best mode to complete delivery is to put on forceps, drawing the placenta down to one side. The main advantage of this treatment, as compared with version, is that the chance of saving the child is greater.

Complete artificial separation of the placenta before the birth of the child was recommended by Sir James Simpson for certain cases, in imitation of that spontaneous complete separation which sometimes occurs. This would generally mean separation far beyond the zone of unavoidable separation, and is therefore not advisable. The only case in which it might be expedient is that in which, the hand being introduced to turn, the placenta is found in the way, and already almost entirely separated by nature.

In the lying-in period, antiseptic vaginal irrigation should be carried out with special care. If any serious septic symptoms arise, intra-uterine injections should also be used.

HÆMORRHAGE FROM SEPARATION OF A NORMALLY SITUATED PLACENTA, OR ACCIDENTAL HÆMORRHAGE.

Causation.—Accidental hæmorrhage rarely happens to primiparæ, and is most common in debilitated women, and those who have had many children. This is an indication that there is generally some morbid condition of the uterus or placenta as a predisposing cause. Such predisposing causes are similar to those which cause hæmorrhage and abortion in the earlier months, namely, all diseased conditions of the placenta which cause undue vascular tension, or weakness of the vessels or of the placental attachment. Generally there is, in addition, some exciting cause. This may be direct violence to the abdomen, or a fall or shock, or excessive muscular exertion, such as lifting weights. Sometimes there is only an emotional cause, which probably acts by exciting violent or irregular contractions of the uterus. In comparatively rare cases there is no obvious exciting cause. In some instances a slight effusion of blood under the placenta, due to some diseased placental condition, may excite irregular uterine contraction, leading to further separation of the placenta and hæmorrhage.

Pathological Anatomy.—From partial detachment of the placenta, blood is poured out between the placenta and the uterus. In most cases this blood, or some part of it, reaches the edge of the placenta, separates also the membranes, and escapes at the os uteri. Frequently a considerable amount of clot remains behind within the uterus, behind the placenta, or between the membranes and the uterine wall. The placenta may be hollowed out, so as to present a concave surface outward, if the clot lies mainly behind it. A comparatively rare variety is *concealed accidental hæmorrhage*, in which no blood, or scarcely any, makes its appearence externally. If the placenta remains attached at its margin at all parts, a considerable amount of blood may be poured out behind it, without any at all reaching the exterior. Or the blood may be retained near the fundus, between the membranes and the uterus, the uterus not acting strongly. Or again, if labour has commenced, the escape of the blood may be prevented by the head closely fitting and filling up the os uteri. The uterus may be distended by the blood and clots effused, especially in the concealed variety of accidental hæmorrhage. In some cases the distension has even been sufficient to rupture the uterus. In general the amnion is not ruptured, and no blood finds its way into the amnial cavity. Sometimes, however, rupture does occur from the placenta or elsewhere, and one variety of concealed accidental hæmorrhage may thus arise, the blood passing into the amnial cavity instead of escaping externally. In the majority of cases accidental hæmorrhage occurs before there is any sign of labour, but sometimes the bleeding commences in the early stage of labour, or at any rate becomes manifest first at that time. It has already been explained, in the description of placenta prævia (see p. 422), that, in a certain number of cases ranked as accidental hæmorrhage, there is a predisposing cause for separation in the placenta being attached low down in the uterus, not within the zone of unavoidable detachment, but in the intermediate or dangerous zone, where the placenta is put to some slight strain in dilatation of the cervix, and receives shocks communicated through the pelvis more directly than when implanted near the fundus uteri.

Symptoms and course.—The symptoms are those produced by hæmorrhage, sometimes accompanied by pain, from distension of the uterus. The majority of the cases are comparatively mild, but in the severe cases the anæmia and prostration are apt to be greater even than in placenta prævia, since the placenta may be separated more suddenly and widely. Symptoms of collapse, with failure of pulse, are most marked of all in the cases of concealed accidental hæmorrhage. The patient may die from hæmorrhage undelivered. As in placenta prævia, post-partum hæmorrhage is also more liable to occur than usual, on account of the patient's exhaustion, and death shortly after delivery is not uncommon.

Diagnosis.—When blood and clots appear externally, the distinction has to be made from placenta prævia. A probable diagnosis may be made when there has been a blow, fall, or other exciting cause for accidental hæmorrhage. A positive diagnosis is made when the cervix is open enough to admit the finger, and no placenta is found within reach. Examination of the membranes after delivery will generally show whether the placental insertion encroached upon the dangerous zone. Assuming that the membranes were punctured or gave way near the centre of the os uteri, the aperture in the membranes will be found to be nearer than usual to the margin of the placenta at some part, if the placental insertion has been lower down in the uterus than usual.

Concealed accidental hæmorrhage may be more difficult to diagnose, if no blood whatever escapes externally. The chief signs to judge by are sudden collapse and faintness, feeble pulse, sometimes vomiting, accompanied by general appearance of anæmia, and pain in the uterus. The uterus on palpation will be more uniformly tense than usual, not much varying in firmness by rhythmical contraction. Sometimes it may be recognised as increased in size from the effusion into it, especially if full term is not yet nearly reached, as for instance at the sixth month. Concealed accidental hæmorrhage has to be distinguished from rupture of the uterus, but rupture is not likely to occur (except from great direct violence) before the onset of labour, or even before escape of the liquor amnii. In cases of accidental hæmorrhage, mainly of a concealed character, there is often a slight escape of blood per vaginam, which reveals the real nature of the case.

Prognosis.—The milder cases nearly always do well, but in the graver ones the risk of death directly from hæmorrhage is even greater than in placenta prævia. Out of 49,145 deliveries in the Guy's Hospital Lying-in Charity there were 105 cases of accidental hæmorrhage, as compared with 92 of placenta prævia. There were 12 deaths from hæmorrhage, as compared with 8 directly due to hæmorrhage in placenta prævia. Of the more serious cases, the children were still-born in about 60 per cent. The risk to the child, in a grave case, is therefore not much less than in placenta prævia. The cases of concealed accidental hæmorrhage are relatively rare ; there was only 1 in the 105 cases above mentioned. A considerable number, however, has been recorded, and Dr. Goodell has collected 106. In these, the mortality to the mothers was nearly 51 per cent. ; to the children 94 per cent. Concealed accidental hæmorrhage is therefore much more dangerous to both mother and child than accidental hæmorrhage in general. The reason probably is partly that the element of shock through distension of the uterus is superadded, and partly that the very fact of the uterus allowing such distension proves that its walls are feeble, or not prone to contract.

Treatment.—The membranes should be punctured as soon as possible and ergot administered, either a subcutaneous injection of ergotine or a drachm of the liquid extract, repeated if necessary. If the cervix will not allow the finger to pass to reach the membranes, they should be punctured by a uterine sound, or, in the absence of this, with a catheter stylet, or piece of thick wire. The instrument is passed through the cervix like a sound till it is felt to rest against the ovum. Then a sudden push is given, and the membranes will commonly be felt to give way. The instrument should be moved a little laterally to tear an opening in them. If the abdominal pressure is slight, very little liquor amnii may escape till the uterus contracts. But the operator should not be satisfied till he sees enough fluid to convince him that the membranes are really ruptured. Plugging the vagina is considered inadmissible in cases of accidental hæmorrhage, because concealed hæmorrhage might be going on behind the plug. The practitioner ought to be able in any case to rupture the membranes. After the puncture of the membranes, the uterus should be stimulated by external pressure and friction, or by a binder. The patient should be kept in bed, and the position should be the dorsal position rather than the lateral, to promote the stimulating pressure upon the cervix, and prevent blood collecting at the fundus. Frequently, after escape of the liquor amnii, the uterus acts well, and hæmorrhage is arrested. If pains are feeble from exhaustion, or bleeding continues, labour should be accelerated by forceps if the os is dilated enough, and the head can be easily reached. Care must be taken not to empty the uterus too rapidly, and to keep the fundus well stimulated by external pressure at the final stage of delivery.

If bleeding continues, and the os is not dilated enough for forceps, the best treatment is to dilate the os digitally till forceps can be applied, or, if the os is very resistant to dilatation, to perform version. If, however, the patient is greatly collapsed and the pulse very bad, it is preferable if possible to wait a while, and try to restore her with stimulants and nourishment rather than to perform version at once. In states of great collapse it must be remembered that ergot in large doses acts as a depressor of the heart. Quinine (5 or 6 grains) may then be given in preference. With such a state also, either no anæsthetic should be given, or ether alone used. Great care must be taken to avoid any post-partum hæmorrhage. In the majority of cases, and especially in all milder cases, the puncture of membranes and administration of oxytocics will be found sufficient treatment without recourse to forceps or version.

The case, however, is one of extreme difficulty and danger if hæmorrhage continues after the rupture of the membranes, and the os is small and undilatable. The performance of Cæsarian section under such circumstances has been proposed; and, in one case at any rate, actually carried out with success.

It is important for the student to remember the correct treatment of accidental hæmorrhage, not only for the sake of his patients, but because a question on this subject is frequently a fatal one in examination, especially if plugging the vagina be suggested as treatment.

CHAPTER XXVI.

PRECIPITATE AND PROLONGED LABOUR.

PRECIPITATE LABOUR.

LABOUR may be precipitate when the expulsive force is unusually powerful in proportion to the resistance to be overcome. Excess in the force of the pains has to be considered, not absolutely in itself, but in relation to the resistance and the strength of the resisting tissues. Thus precipitate labour may take place when the expulsive force is normal, if there is unusually small resistance from large relative size of the pelvis and softness or dilatability of soft parts. It may also happen with normal resistance if the expulsive force is excited to excessive action by undue reflex irritability, and 3) again with resistance above the normal, and a still greater excess of irritability.

Precipitate labour depending on smallness of resistance, though described as an abnormality, has rarely any ill effect. In such a case the passage of the child may take place in a few minutes. The chief risks to be feared therefore are the inconvenience of delivery taking place suddenly and unexpectedly, and the danger to the child from its being born in some unusual position. In such cases the child has been expelled into the pan of a water-closet. Still more frequently it has been born when the mother was standing upright, and fallen upon the floor, breaking the funis. Even then the injury suffered by the child has generally not been so severe as might be expected, for the fall is broken by the resistance of the funis, and when the funis is thus violently torn across, bleeding generally does not take place from the severed end. There appears to be a somewhat greater risk of the uterus becoming relaxed after delivery, and allowing hæmorrhage, when it has not been called fully into activity by a reasonable amount of resistance. Even this result, however, is exceptional, and more usually the uterus contracts well after rapid labour.

The risks are greater when, with a normal or an excessive resistance, the expulsive force is excited to undue degree by unusual reflex irritability, or by injudicious administration of oxytocics, such as ergot. There may be excess of intensity in the action of the uterus itself, or of the auxiliary muscles, or both together. Or again, the usual intervals of rest between the pains may fail, and the pains may follow each other in stormy succession, almost without intermission, especially as the final stage of labour approaches. The chief danger of excessive intensity in the expulsive force is that of laceration either of the cervix or perineum, the soft parts having no time to dilate under the influence of repeated and moderate pains. Sometimes even rupture of the uterus involving the peritoneum may occur, even though no bony obstruction exists. If there is moderate pelvic obstruction fracture of the cranial bones of the child may be produced. From excessive straining in bearing down, emphysema of the neck, face, and chest is sometimes produced, from rupture of some air vesicles in the lung.

When pains come on in rapid stormy succession, they are generally also intense in degree, and a similar danger of laceration exists. There is also danger of the child becoming asphyxiated from the pressure upon it not being relieved by intermissions. Intense mental excitement is sometimes produced by the rapid succession of agonizing pains, and this may even amount to temporary mania, so that a patient is not responsible for her actions.

Treatment.—If precipitate labour from deficient resistance is anticipated, the only treatment necessary is to keep the patient continually recumbent in the lateral position from the commencement of pains, and to be careful to secure adequate uterine contraction after delivery. If the expulsive force is excessive and threatens laceration, it is also well to keep the patient in the lateral or, still better, the semi-prone position, so that the pressure on soft parts may not be assisted by gravity. Over-action of the auxiliary muscles may be kept in check to a considerable extent by voluntary control. The patient should not have any support to hold to by the hands, or press against with the feet, and should be exhorted not to hold her breath, but to cry out during the height of a pain. The most effective remedy, however, for excessive action both of the uterus and auxiliary muscles is the administration of chloroform. By this means the pains may be moderated to any desired extent. Failing chloroform, a subcutaneous injection of morphia may be given, but it is not so effective. Chloroform will equally moderate an unduly rapid succession of pains, and abolish the nervous excitement therefrom resulting. When the obstacle lies at the vaginal outlet and perineum, especially in primiparæ, and excessive or rapidly following pains threaten laceration, the perineum may often be saved by delaying the advance of the head in the manner previously

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described (see page 214). This is greatly facilitated if the patient is under chloroform, since otherwise she is likely to lose self-control at the height of a pain, and throw herself into such a position that the physician is powerless.

PROLONGED LABOUR.

Labour may be prolonged by an absolute inefficiency in the expulsive force, or by an insuperable resistance in the pelvis or soft parts. In the majority of cases of prolonged labour, however, there is only a relative disproportion between the force and the resistance. The resistance is greater than normal, and the force, either from the first, or when the patient is beginning to get exhausted from her efforts, is insufficient to overcome it within a moderate time. In primiparæ, even the resistance of the vaginal outlet and perineum not unfrequently is sufficient to produce this effect, the pains, which at first may have been satisfactory, becoming inefficient after a time.

General effects of protracted labour.—Undue prolongation of labour always increases the risk to the mother, even when the prolongation is only in the first stage, at which it is of comparatively slight consequence. There is a certain similarity in the symptoms which arise in prolonged labour, whatever the cause of prolongation. They depend in some degree upon the continuous pressure exerted by the fœtus, but to a much greater extent upon the effect upon the nervous system of the fruitless efforts of the uterus. If the delay depends only upon feeble pains, and especially when this is the case in the first stage of labour before rupture of the membranes, a very long time may elapse before serious efforts become manifest. The more vigorous are the fruitless efforts of a strongly-acting uterus to overcome an obstacle, the more quickly do the grave constitutional effects of exhaustion appear. The first marked effect is upon the pulse, which, instead of being only moderately accelerated during the pains, as by muscular exertion of any other kind, gradually rises above the rate of 100 per minute, and eventually to a rate of 120 or more. At the same time the patient becomes anxious, distressed, and restless, the copious lubricating secretion from the cervix and vulva fails, and the parts become dry and hot, often swollen. Eventually even a slough may form at the part most exposed to pressure. The tongue becomes coated and finally dry and black. The temperature rises, and nausea and vomiting are often marked. Eventually, within a limited number of hours, the patient would sink from exhaustion, the pulse becoming progressively

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feebler and more rapid. Of these symptoms the earlier, and especially the acceleration of the pulse, should always be a sufficient indication for interference, and the more formidable ones should never be allowed to arise.

Continuous action of the uterus.—The effect upon the uterus itself is one of the utmost importance to recognise. For a considerable time a strongly acting uterus is stimulated by resistance to more vigorous pains. Eventually, however, if it is unable to overcome the obstacle, and no rupture occurs, the pains appear to become feebler and cease. The uterus however does not usually become lax, but gets into a state of continuous or tetanic contraction, unbroken by any rhythmical pains, so that it feels firm and hard when the hand is placed upon the abdomen. The useless energy expended in such tetanic contraction still further exhausts the nervous system. It has moreover the effect that, if all the liquor amnii has escaped, the parts of the uterine wall in contact with projections of the fœtus are subjected to prolonged pressure while those parts which correspond to depressions and are so relieved from pressure, become intensely congested.

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While a strongly acting uterus will fall at length into this state of tetanic action, if the obstacle is insuperable, a feebly acting uterus may do so at a much earlier period. Thus in many cases which were formerly regarded as simply "powerless labour," the condition is really one of continuous action of the uterus. Cases of true inertia alone are distinguished by the softness and laxity of the uterus, and by the fact that the pulse is quiet, whereas in continuous action it is always accelerated. As a rule, it is only in the second stage of labour, and after the rupture of the membranes, that continuous action of the uterus is apt to come on. In very exceptional cases, however, it may do so even in the first stage, when there is an insuperable obstacle to dilatation of the os, such as cancer or cicatricial closure. In some such cases, continuous action may even supervene without any vigorous rhythmical pains ever having been apparent. Any degree of this continuous action or "tetany" of the uterus, associated with cessation of rhythmical pains, should always be an indication for affording assistance. It is an absolute contra-indication to the administration of any oxytocic, as ergot.

Retraction of the uterus.—Besides the constitutional symptoms, all protracted labour, unless due to pure inertia of the uterus, tends to produce a certain local effect. The effect of repeated pains, if they are unable to cause advance of the fœtus, is to stretch gradually more and more the cervix together with the adjoining extensible portion of the body of the uterus. In corresponding degree the strong muscular portion of the body of the uterus retracts,* shrinks, and becomes thicker, while, by gradual escape of the liquor amnii, it more closely grasps the fœtus. The consequence is that both the internal os uteri, and the retraction ring or line of demarcation between the retractile and extensible portions of the body of the uterus (the so-called ring of Bandl, according to some authorities) travel gradually upward. One of these lines, probably that indicating the internal os,† may sometimes, after protracted labour, be felt on external examination as a transverse line of depression across the abdomen, some distance above the pubes. If such a line is detected at a considerable height above the pubes, it is an indication both that interference is required, and that the case has advanced too far for version. When retraction has proceeded beyond a certain point, the power of the uterus is diminished thereby, notwithstanding the thickening of its walls produced, as the muscular fibres, having already shortened themselves to a considerable extent, no longer exert so much force.

The extensible zone, as it is stretched, eventually undergoes dangerous thinning. This may lead at last to rupture, commencing in the thinned portion, but extending perhaps beyond its limits. The internal os uteri may travel so far upward as to pass above the head of the fœtus, even when this is prevented from descending far into the brim. It may then contract somewhat around the neck, being the part of the uterus which has the strongest circular muscular fibres. If version is attempted in this state of affairs there is danger of laceration, since, to elevate the head, it is necessary to push it past a constricting ring. In the frozen section (Fig. 73, p. 156) the position of the internal os is shown elevated to the point *o i*, probably indicating that, in this case, there must have been considerable protraction of labour.‡ As a rule the excessive retraction of the muscular portion of the uterus occurs only after rupture of the membranes, when the advance of the fœtus is obstructed. In rare cases it may happen even in the first stage, when pains of fair strength have been long continued, but some powerful resistance to dilatation of the external os exists. When this is so, protraction even of the first stage becomes serious.

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* "Retraction" means the contraction and shortening of the uterine muscle, not followed by relaxation.

† But the two lines may possibly sometimes coincide (see note, p. 107).

‡ Considerable doubt has existed as to the significance to be attached to Braune's important frozen section (Fig. 73, p. 156), as evidence with respect to the position of the internal os uteri in labour. Braune considers the internal os to be at the position marked *o i* in the figure, close to which, on the anterior wall, is the transverse section of a large venous sinus. Some authorities, however, unwilling to admit that the internal os is displaced so much upwards in normal labour, interpret this line as being the so-called ring of Bandl, which they regard as being the demarcation between the contracting and the stretched zone in the body of the uterus, and consider that the internal os really lies near c in the figure. It seems improbable, however, that such a marked projecting ridge as that shown at *o i* on the posterior uterine wall would be produced at any point except one like the internal os, which is provided with specially strong sphincter-like circular muscular fibres. Nor has any evidence from autopsies been adduced to prove that there is anything but a gradual transition between the retracting and the expanding zone in the body of the uterus. It has already been remarked (see p. 159) that, although there is no evidence of contraction in the pelvis

Effects produced at the several stages of labour.—The first stage of labour, before escape of the liquor amnii, may be long protracted, sometimes even for several days, without very serious effect to either mother or child, both being protected from undue pressure by the equable support of the liquor amnii. If protraction is only due to uterine inertia at this stage, the patient suffers little more than the FATI effect of fatigue and loss of sleep. If it is due to rigidity or other morbid condition of the cervix, the constitutional effects of protracted labour come on sooner or later. Protracted labour in the first stage, after premature rupture of the membranes, is much more serious. The life of the child is endangered by prolonged pressure, the greater part of the liquor amnii gradually draining away. The futile efforts of the uterus also at length bring on the symptoms of nervous exhaustion already described. Much longer delay can however be tolerated with impunity at this stage than later on, both by mother and child. The child suffers less because there is less powerful reflex stimulus to uterine action than when the head is resting upon the vagina or perineum, the mother for the same reason, and also because the vaginal tissues are not yet endangered by pressure of the head, lying deeply in the pelvis. In pelvic and face presentations, labour, especially in its earlier stage, is naturally more protracted, and less harm than usual results, particularly in pelvic presentations, since the shape of the presenting part causes less pressure.

Protraction of the second stage, after the external os uteri is completely retracted over the head, is the most serious of all, and produces grave symptoms within a very few hours. Sloughing is especially likely to occur at the anterior vaginal wall, if delay is allowed to continue very long, and to be followed by vesico-vaginal fistula. Delay at this stage is also the most likely to prove fatal to the child through asphyxia. It is under these circumstances that the modern

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shown in Fig. 73, labour may have been protracted in consequence of the fact that the membranes are still unruptured although the expulsive stage of labour is far advanced. Further evidence is therefore required to determine how far the internal os is elevated in normal labour. Balfour's frozen section from the second stage of labour does not settle the question ("Brit. Med. Journ.," Nov. 8, 1890). It shows a ridge projecting inwardly at about the same level as *o i* in Fig. 73. This is apparently not the internal os, and is regarded by Balfour as the retraction ring. But it may merely be moulded on the fœtus, and correspond to the groove above the fœtal arm not indicating anything at all in the uterus.

practice of giving much more frequent assistance by forceps than was usual in former days is both most beneficial, and, at the same time, free from any difficulty or danger.

ANOMALIES OF THE EXPULSIVE FORCE.

Inertia of the uterus.—Feebleness of uterine action may be either due to deficient nerve force dependent upon such constitutional debility, or to thinness, weakness, or fatty degeneration of the uterine muscle. The latter condition is itself generally dependent upon the constitutional state. Inertia may therefore result from any exhausting disease, from constitutional debility, from any cause of malnutrition, such as vomiting, or from residence in a hot climate. As might be expected, it is more common among women of the upper classes, not accustomed to much muscular exertion, than among women used to hard work. On the other hand it is common among the poor who are unable to get sufficient nourishment, especially if resident in towns, and leading sedentary lives. If pregnancy occurs in very young girls, the uterus is apt to be insufficiently developed. This may also occur if women much beyond the usual age become pregnant for the first time, but is not then so usual. A distended bladder or loaded rectum often interferes with the development or continuance of effective rhythmical pains. The influence appears to act to a great extent through the nervous system, though it is also partly mechanical, especially in the case of a distended bladder, which is a direct impediment to the action of the auxiliary forces. Excess of liquor amnii or twin pregnancy also tends to produce inertia, the over-distended and therefore thinned uterine wall being naturally more feeble in its contraction.

The so-called "polarity of the uterus," or correlation between the condition of the body of the uterus and that of the cervix, according to which a quiescent state of the body of the uterus is associated with muscular tonicity of the cervix, and active expulsive pains with physiological relaxation of the circular muscular fibres of the cervix, has already been explained (see pp. 148, 149).

In consequence of this correlation it happens that, in the first stage of labour, inertia of the uterus, or a tendency to tonic contraction instead of active rhythmical pains, is apt to be brought about if the natural mechanism of dilatation of the cervix does not act satisfactorily. The cause may be a want of the natural projection of the bag of membranes, either from deficiency of liquor amnii, inelasticity of membranes, or their adhesion around the os, or again it may be premature rupture of the membranes, rigidity of the cervix from some previous morbid state, or spasm of it set up by over-frequent examinations or any other cause.

There may also be a secondary inertia in the second stage of labour, when some obstruction exists, such as the rigidity of soft parts in a primipara, and a weak uterus, easily wearied by its efforts, falls into a state of laxity when it fails to overcome the obstruction. The term inertia should not however be applied to the more dangerous condition of continuous action (see p. 439) supervening upon obstructed labour.

Irregular and painful uterine contractions.—The amount of pain produced by uterine contraction is by no means proportional to its mechanical power, which must be estimated by its effect upon the bag of membranes, or presenting part. Not unfrequently contractions are excessively painful at the same time that they are inefficient. This character in the pains may last throughout the whole labour, and in such case it may depend either upon the neurotic over-sensitive character of the nervous system, or upon some inflammatory or other morbid condition of the walls of the uterus. Women who have previously suffered from a dysmenorrhœa mainly of the neuralgic or neurotic type are liable to be affected in this way. The excessively painful character of the contractions seems itself directly to impair their efficiency, especially by its interference with bearing-down efforts.

There is another kind of excessive painfulness in the uterine action, depending upon the nature of the contraction itself, which is irregular and cramp-like, affecting the uterus unequally, and so producing little or no effect upon the os uteri or presenting part. A part of the distress occasioned by such pains is the consciousness of the patient herself that they are useless. Irregular contractions occur especially in the first stage of labour. Women of over-sensitive nervous system are more prone to them, as they are to the merely over-painful contractions. They are liable to be set up by any source of reflex irritation acting upon the nervous system, such as indigestion, or a loaded rectum. One variety constitutes the well-known "spurious pains" coming on before the real onset of labour, and producing no effect upon the cervix. These are generally dispelled by an aperient. Irregular contraction may also be set up in the first stage, when there is something to interfere with dilatation of the cervix, such as morbid adhesion of the membranes around the os, or rigidity of the cervix; sometimes also even in the second stage, when the uterus finds itself unequal to resistance with which it meets.

Inefficiency in the auxiliary forces.—Although the action of the uterus is the most important part in labour, yet, when the resistance is somewhat greater than usual, a deficient action of the auxiliary muscles may be of considerable consequence, partly from the fact that the bearing-down efforts act as a stimulus also to the uterus itself. This deficiency occurs when there is any affection of heart or lungs, which prevents the patient holding her breath in order to fix the diaphragm and bear down; when the abdominal walls have been overstretched by previous pregnancies, or by any other cause; and when ascitic fluid, or tumours of any kind, are present in the abdomen. The auxiliary forces may also be feeble from muscular weakness, or when the patient is so deficient in self-control and unable to bear pain that she persists in crying out even in the pains of the expulsive stage, and will not hold her breath to bear down.

Deviation of the uterine axis.—There is generally some obliquity of the uterus toward the right side, but in some cases lateral obliquity is excessive. A more important and common deviation is anteversion of the uterus, depending upon undue laxity in the abdominal walls, found chiefly in women who have had many previous pregnancies. The fundus may then hang forward and even downward over the pubes, so that the presenting part is directed backwards against the sacrum or lumbar vertebræ instead of towards the pelvis. Deviation of the uterine axis is of comparatively little consequence until the membranes are ruptured. After this, the efficacy of the force in causing advance of the fœtus is reduced in proportion to the cosine of the angle of deviation. Useless and additional injurious pressure is called out, equal to the product of the force and the sine of the same angle. In this way, in anteversion of the uterus, if a sudden pain occurs when the patient is upright, it may even cause rupture of the vagina or cervix at its posterior part, without the existence of any unusual obstruction.

Treatment in the first stage of labour.—The main remedies for uterine inertia in the first stage, while the membranes are intact, are time and patience. Investigation should first be made as to the presence of any source of reflex disturbance capable of removal. Thus the effect of a copious enema is often very satisfactory. Beyond this, the chief points to be attended to are to keep up the strength of the patient by a sufficient amount of food, and to secure her a reasonable amount of sleep. For this purpose a dose of opium or chloral may be administered. Pains often diminish from the effect of fatigue, and, after a sleep, return with renewed vigour. In the intervals the patient should be up and moving about as much as possible, not continually reclining. When she lies, the dorsal position should be preferred, so as to secure the

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greatest pressure upon the cervix. If the contractions are irregular and unusually painful as well as inefficient, chloral should be administered in the mode already described (see p. 225). In the case either of spasmodic irregular pains, or of great protraction of the first stage, especially if the bulging of the bag of membranes is not satisfactory, it is well to make sure that the membranes are separated from the uterine wall for some distance within the os. If any adhesion exists, artificial separation will often considerably accelerate labour. To do this, two joints or the whole length of the index finger should be passed within the os and swept round in a circle. In multiparæ, when the vagina is capacious, the half or whole hand may be passed into the vagina to carry this out. Otherwise the patient should be placed on her back, the fundus pushed somewhat backward, and the cervix drawn forward by the index finger hooked into it, until it is near enough for the finger to sweep round the anterior segment. If the posterior segment cannot be reached by the finger, a large gum-elastic catheter guided by a strong stylet having only a slight curve may be used for this part, care being taken not to rupture the membranes.

If the os is soft and dilatable in a case of inertia, and especially if it is suspected that the liquor amnii is excessive, it often accelerates matters to puncture the membranes rather before full dilatation of the os has been reached. Nothing, however, calls for more judgment and experience than the decision when this can be done with advantage. If the membranes are ruptured prematurely in an unsuitable case, the os may become rigid from spasm, lubricating secretion may fail, and the case be much more protracted, and the patient suffer much more, than she would otherwise have done.

If there is rigidity of the os as well as inertia, so long protraction must not be allowed. Artificial dilatation must be undertaken if the pulse becomes much accelerated, or if retraction of the uterus becomes manifested by a transverse line of depression being felt on external palpation. If the liquor amnii has escaped, it is still more necessary not to allow too long delay; but here also acceleration of the pulse will be the most valuable guide. The mode of interference will be described in the section on morbid conditions of the cervix.

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Treatment in the second stage of labour.—If pains are inefficient in the second stage, care should be taken to correct any deviation of the uterine axis, especially anteversion. If anteversion exists, the fundus should be supported by a firm binder, and the patient should lie on her back. The dorsal position has the advantage in all cases of inertia, at any rate until the head is passing the vulva; for gravity then aids the advance of the child, and increases the pressure on soft parts and thereby reflex stimulus. Examinations may also be made with advantage more frequently than under ordinary circumstances, provided that there is no dryness or swelling of the soft parts; for the pressure of one or two fingers in the vagina, and, still more, the pressure on the perineum of the remaining fingers folded back, tend to increase the reflex stimulus to the uterus.

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In all cases of marked inertia the use of chloroform should be avoided if possible, or it should be administered very sparingly, not only because it tends to prolong labour in such cases, but because there is then increased risk of post-partum hæmorrhage.

External pressure.—Another valuable mode of stimulation is the use of external pressure. This has been employed from time immemorial by various savage races, often by very rough and rude methods. When resistance is slight, the direct effect of pressure may cause advance of the fœtus, even in the absence of a pain, but the chief value of the method is its stimulating effect upon the uterus. It may be carried out when the patient is in the lateral position, but more conveniently when she lies on her back. Two hands are laid upon the fundus uteri, and, as soon as the first hardening of the uterus at the beginning of a pain is felt, it is stimulated by friction. At the height of the pain steady pressure is made downward and backward in the uterine axis. Some patients are more tolerant than others of this pressure, and it must not be carried so far as to give great pain. The same process is repeated with each succeeding pain. Even in the absence of pain, friction and kneading with moderate pressure may be used at intervals of a few minutes, in the hope of exciting pains. The plan is only to be adopted when inertia is the sole cause of delay, not when there is exhaustion, continuous action of the uterus, or any serious obstruction to delivery.

Oxytocic drugs.—Of the various drugs reputed to cause uterine contraction, only two are deserving of consideration here, namely, ergot and quinine. In former days, when the application of forceps was regarded as an operation very rarely to be undertaken, ergot was used much more frequently than now. There are several disadvantages in its use. It frequently not only intensifies the pains, but brings on a tonic contraction of the uterus in the intervals, which greatly increases the risk of the child dying from asphyxia. When exhaustion is approaching, it may simply bring on the state of continuous action, without increasing the rhythmical pains at all. Children stillborn from prolonged labour are therefore more frequent in the practice of those who use ergot frequently, and, moreover, the use of the drug involves the risk of inducing that condition of continuous uterine action which is now well recognised as highly dangerous to the mother. If used before full dilatation of the os and its retraction over the head, ergot may cause spasmodic rigidity; if used injudiciously, when any obstruction exists, it may cause rupture of the uterus. The only case in which ergot may be used with safety is when it is quite certain that inertia is the only fault, and that no obstruction exists. NB To secure this condition, the patient must be a parous woman, who has had no difficulty in previous confinements, the uterus must be quite lax in the intervals of pains, the pelvis of good size, the os fully retracted over the head, the head easily moveable, and with no considerable caput succedaneum, the fœtal heart unimpaired in force and frequency, and the mother's pulse quiet.

Quinine, given in a full dose of 6 to 10 grains, also has a stimulating effect upon the uterus, and is less likely to induce continuous action instead of expulsive pains. In general, therefore, it may be used in preference to ergot, when uterine inertia is the cause of delay. If ergot is used, it may be given in doses of 30 to 60 grains of the powder, made into fresh infusion with boiling water, or 30 to 60 minims of the liquid extract. The effect of any oxytocic drug generally becomes manifested within twenty minutes 20m or half an hour. If any has been administered, the condition of the patient should be carefully watched, as well as the fœtal heart, and the physician should be prepared to aid delivery with forceps, within a moderate time, if the effect of the drug is not satisfactory or sufficient.

In general, ergot should be reserved for the purpose of acting upon the uterus after delivery, at which time its property of inducing tonic contraction is of special value to avert the risk of hæmorrhage. When, however, uterine inertia throughout the course of labour has been so marked as to indicate a risk of post-partum hæmorrhage, or when a patient has had serious flooding in former deliveries, a dose of ergot may with advantage be given before delivery, in two conditions—first, just as the head reaches the perineum, when there is no prospect of obstruction at that stage; secondly, just before the application of forceps, when it has been decided to terminate labour by their means.

Faradisation.—Uterine contraction may be stimulated by a Faradic current. The objections to this treatment have been—first, that the instrument is often not at hand when wanted; and, secondly, that the current is rather painful to the patient. Dr. Kilner, electrician to St. Thomas's Hospital, has published his experience,* that a Faradic current not only intensifies the pains, makes them more frequent, and terminates labour quickly, but at the same time acts as an anodyne, and renders chloroform unnecessary. The current used by Dr. Kilner is a very weak one—not sufficient to produce contraction of a normal adductor pollicis. The electrodes are broad pieces of spongio-piline placed at each side of the uterus below the level of the umbilicus, and secured by a bandage. The battery is an extremely compact and portable one, made by Trouvé, 6, Rue Térèse, Paris. With such a weak Faradic current, I have not been able to convince myself that any real effect is produced, either as a stimulant or an anodyne.

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* Obstet. Trans., Vol. XXVI.

Application of forceps.—In the great majority of cases of prolonged labour, the cause lies not merely in uterine inertia, but in some degree of extra resistance, due either to slight disproportion between the fœtal head and the pelvis, or rigidity of the soft parts, such as is especially frequent in primiparæ. Under these circumstances, the administration of ergot is analogous to applying a spur to the already overtaxed uterus, and is liable to end in a still more complete exhaustion. It is now generally agreed that it is a more scientific plan to supplement the insufficient expulsive force by the *vis a fronte* exerted by means of forceps. Even if the only fault is inertia, there is no harm in extraction by forceps, provided care is taken to secure due contraction of the uterus after delivery, and so avoid post-partum hæmorrhage. It is not now a question of the high forceps operation, in cases in which there is an obstruction preventing the head descending into the pelvis, or of the application of forceps when delay is due to the failure of the cervix to dilate. In both these conditions application of the forceps is a much more serious matter, only to be undertaken for grave reason. But when the head has so far entered the pelvis as to be easily grasped by the forceps, and the cervix is either completely retracted over the head, or so far dilated that it no longer offers an obstacle to delivery, extraction by forceps is both easy and practically almost free from risk.

Indications for use of forceps.—Recourse should be had to forceps long before any of the graver symptoms of protracted labour, which were before enumerated (see p. 438), have appeared. Acceleration of the pulse is the most valuable practical indication of the necessity for interference. The minimum pulse-rate, taken in the intervals of pains, is the rate which must be taken as a guide. It is to be remembered that some persons have habitually a rapid pulse, especially those suffering from any heart affection, or from alcoholism. These cases will generally be distinguished by the pulse having been rapid from the very outset of labour. It must also be remembered that a rising pulse may be the effect of alcohol given during labour by injudicious friends. Setting apart these cases, it may be said, as a general rule, that when the pulse has risen from a moderate rate to exceed 100 per minute in the second stage of labour, the os being dilated, artificial assistance is desirable. One case must be excepted, namely, that in which, toward the end of labour, vigorous pains come on in rapid succession. These are often accompanied by a pulse rising to a high rate, simply from the absence of intermissions. In this case instrumental interference is superfluous, if any progress is being made, for the labour is likely soon to be completed by nature.

Even before the pulse rises sufficiently to indicate a necessity for interference, forceps may be applied with advantage, if, after complete retraction of the cervix, the head is detained for any long time, more than two hours or so, in the vagina, or resting on the perineum, and little or no progress is being made. Longer time should of course be allowed for this stage in primiparæ than in parous women, since in the former longer time is naturally required for the dilatation by successive pains of the vaginal outlet and perineum, and laceration is more likely to occur if this time is shortened. If the head fits so tightly in the pelvis that it does not recede, and cannot easily be pushed back, in the interval of pains, and if moreover the caput succedaneum is large and increasing, these conditions form additional indications in favour of interfering without waiting long for constitutional symptoms, since they denote that both the fœtal head and maternal soft parts are subjected to serious pressure.

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It cannot be doubted that, by the modern practice of having recourse to forceps without great reluctance, both maternal lives are saved, and the lives of children which would have been stillborn from prolonged pressure. In the present day, however, there is probably little need to urge the expediency of a frequent use of forceps, but rather to caution against the risk of carrying the frequency of their use too far; for practitioners are naturally often exposed to the temptation to apply forceps early, in order to save their own time. In this view it must be remembered that the cases which try the patience most are often those in which the delay is due to difficulty in the complete dilatation and retraction of the cervix. Although, when the head is in the vagina, forceps may as a rule be applied, even unnecessarily, with impunity, this is not the case when the cervix is not fully dilated. There is then a risk of cervical laceration, which not only involves an increased chance of septic absorption, but the prospect that the patient may suffer for years afterwards from the cervical inflammation consequent upon laceration with ectropion.

Some authorities, in urging a frequent use of forceps, have based their recommendation upon the very large saving of fœtal life said to be attained thereby. It does not appear, however, that there are any trustworthy statistics proving that any such large saving can be obtained. Of the total number of still-births, a large proportion are in cases of premature, macerated, or syphilitic children, or the result of malpresentation. The number of these may vary so much in different localities, or in different classes of society, that any inference from the statistics of individual practitioners as to the still-births due to protracted labour, or saved by the early use of forceps, becomes difficult.

Under these circumstances it is of interest to compare the results obtained in two adjoining districts, among populations of a similar character, namely, the Lying-in Charities of Guy's and St. Thomas's Hospitals. Some years ago forceps were used more than ten times as often in the St. Thomas's Charity as they were in the Guy's Charity. Thus, for 12 years (1863–1875), in the Guy's Charity, the forceps-rate was 5·1 per 1000 (about 1 in 200 deliveries); the corresponding rate of still-births in vertex presentations, 2·7 per cent. In the St. Thomas's Charity, in 1874, the forceps-rate was 54·2 per 1000 (about 1 in 18 deliveries); the corresponding rate of still-births in vertex presentations, 2·8 per cent. In 1875, the forceps-rate was 61·8 per 1000 (about 1 in 16 deliveries); the corresponding rate of still-births in vertex presentations, 2·8 per cent. In the above ratios of still-births, premature and macerated children are included. It therefore appears, that, though no one would probably now recommend for private practice so sparing a use of forceps as only one forceps-case in 200 deliveries, yet with this a slightly better ratio of still-births was attained than that in the St. Thomas's Charity with a use of forceps ten or twelve times as frequent. No patient died in the St. Thomas's Charity in these years after the use of forceps, so the practice there was at any rate apparently innocuous to the mothers, if it did not diminish the ratio of still-births.

A similar inference may be drawn from the statistics of the Rotunda Hospital, Dublin. The patients may be presumed to have been of a similar class at different times, but the forceps-rate varied very widely under different masters. Under Dr. Shekleton (1847–1854), the forceps-rate was 16·5 per 1000; the total ratio of still-births, 6·9 per cent. Under Dr. G. Johnston (1871–1875), the forceps-rate was 116·4 per 1000; the total ratio of still-births, 6·1 per cent. Excluding premature and putrid children, Dr. Shekleton's ratio of still-births was 2·7 per cent.; Dr. Johnston's (1868–1875), 2·2 per cent., with an average forceps-rate of 96·4 per 1000. This gives an apparent gain by frequent use of forceps of one-half per cent. But the greater part of this is probably due to the substitution of forceps delivery for craniotomy, Dr. Johnston having introduced the long curved forceps in place of the straight forceps previously used at the Rotunda Hospital. Thus Dr. Shekleton had ·79 per cent. craniotomy cases, Dr. Johnston only ·35 per cent. If the difference between these be subtracted, only a difference of ·06 per cent. in the ratio of still-births remains in favour of the frequent use of forceps.

Neither do statistics show positively any saving of maternal mortality by a forceps-rate much greater than about 1 in 200. At the Rotunda Hospital, under Dr. Shekleton, with forceps-rate of 16·5 per 1000, maternal mortality was 13·0 per 1000; under Dr. Johnston, with forceps-rate of 96·4 per 1000, mortality was 22·0 per 1000. The latter high mortality was mainly due to puerperal septicæmia, and cannot fairly be taken as telling conclusively against a frequent use of forceps. In the Guy's Charity, with forceps-rate of 5·1 per 1000, mortality was 4·4 per 1000. In the St. Thomas's Charity, in 1874, with forceps-rate of 54·2 per 1000, mortality was 7·4 per 1000: in 1875, with forceps-rate of 61·8 per 1000, mortality was 3·4 per 1000; giving a mean mortality for the two years of 5·4 per 1000.

A moderately frequent use of forceps, in cases where interference is not absolutely required, can therefore only justly be recommended on the ground that it shortens the patient's suffering, does not increase her danger, saves the practitioner's time, and effects a slight saving in the rate of still-births. This saving is so slight as to suggest that delivery by forceps must in itself involve some increased risk to the child, counterbalancing in some measure the advantages gained by shortening the labour.

No positive general rules can be laid down as to the frequency with which it is desirable to use forceps, since much depends upon the race of the patients, their position in life, and other circumstances. The results of the St. Thomas's Charity above quoted appear to show that a forceps-rate as high as 1 in 16 or 1 in 18 deliveries does not endanger the mothers, but wider statistics on this point are to be desired.*

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* See papers by the author: "Effects of a frequent Use of Forceps upon the Fœtal and Maternal Mortality," Obstet. Journ., Vol. V., 1877. "Fœtal Mortality in Obstetric Practice," Obstet. Journ., Vol. VI., 1878.

Uteri.
Circular muscular fibres
at internal os.

CHAPTER XXVII.

LABOUR OBSTRUCTED BY ANOMALIES OF THE SOFT PARTS.

Spasmodic Contraction of the Cervix Uteri—Trismus Uteri.—The strongest circular muscular fibres of the uterus are those of the cervix. The action of these is especially marked at two points, the internal and the external os, especially the former, which forms the main sphincter of the uterine cavity, both in the unimpregnated and pregnant condition. In normal labour at full term, the internal os becomes dilated, either before manifest pains set in, or with the earlier pains. It is therefore chiefly spasmodic rigidity of the external os which is observed as a cause of delay in the first stage of labour. In premature labour, however, and more especially when labour is induced prematurely, as in the case of placenta prævia, eclampsia, or pelvic contraction, spasm of the internal os is not unfrequently manifested. This is not so likely to happen when, as in cases of pelvic contraction, there is time to induce labour by a gradual method, imitating as closely as possible the natural process. It is much more frequent when, as in the case of eclampsia, the process has to be made a rapid one on account of the mother's condition. When spasm of the internal os does occur, it is apt to cause more resistance than that of the external os, since the muscular fibres are more powerful, and extend over a wider space.

Causation.—It has been already described how physiological relaxation of the cervix is normally associated with active expulsive pains (see p. 148). Minor degrees of spasmodic contraction are therefore very common as a cause of delay in the first stage of labour in association with ineffective pains. The extreme form of spasmodic rigidity, which has been called "trismus uteri," and which has sometimes persisted as an obstruction until the effects of the delay upon the patient have been very serious, is a very rare condition. The cause of spasm of the cervix may sometimes be simply inertia of the body of the uterus. More frequently there is some source of reflex irritation causing both one and the other, and to this women of a sensitive neurotic disposition are specially liable.

Premature Rupture
too frequent digital
Painful uterine contractions
Ergot
Malposition

Thus there may be a loaded rectum or a full bladder, or premature rupture of the membranes, interfering with the normal mechanism of dilatation, or the cause may be too frequent digital examination at an early stage of labour, or premature and ineffective attempts at operative interference. Again, the cause may be extreme painfulness in the uterine contractions, due to the patient's over-sensitiveness to pain, or some previous inflammatory condition of the uterine walls. Injudicious administration of ergot in the first stage of labour may have the same effect; and so may malpositions of the fœtus, such as shoulder presentation, when, after rupture of the membranes, it prevents the presenting part descending into the cervix to continue the dilatation.

Often it is difficult or impossible to determine how much of the resistance is due to mere rigidity of tissue, how much to muscular spasm. It is probable that undue organic rigidity is often the cause of superadded spasm, irritation being produced by delay in the first stage. If the os suddenly softens, and begins to dilate quickly, with the accession of expulsive pains, it is proved that the previous resistance was of a spasmodic nature.

Spasm of the internal os is generally due to interference with, or curtailment of, the natural stage of preliminary gradual dilatation. When there is any source of irritation to the uterus, such as prolonged labour from obstruction, the internal os may contract around the neck, above the head. It may also contract around the body, or neck, after delivery of the breech, in pelvic presentations, or after version. After delivery a similar contraction may incarcerate the placenta.

Pro
lab
obs

The very severe and persistent spasm of the cervix, which has been called "trismus uteri," has been sometimes noted in cases of placenta prævia. The organic change in the uterine wall near the internal os, due to the placental implantation, is then probably concerned in the result. It has also occurred in some cases in which the membranes have been injudiciously ruptured artificially in a protracted first stage.

ORGANIC RIGIDITY OF THE CERVIX.—Comparative rigidity of the cervical tissue is a natural condition in primiparæ, and is the cause of the greater length of the first stage which is usual with them. In parous women, it is usually the result of fibrous induration and hyperplasia of the cervical tissue preceding pregnancy. The starting point of this has often been bruising in a former delivery, or laceration followed by eversion. Even in primiparæ there may be fibroid induration resulting from cervical endometritis or chronic engorgement, and rigidity of the cervix is more likely to exist if pregnancy occurs for the first time late in life.

There is a special form of cervical hyperplasia and fibroid rigidity depending upon procidentia of the uterus (or prolapse of the second degree) previous to pregnancy. This may be of two forms, either elongation with hyperplasia chiefly of the *supra-vaginal* cervix, which is consecutive to descent of the cervix external to the vulva,* or the same condition of the *vaginal* cervix, which is usually primary, and a cause of uterine descent. With such hyperplasia of cervix, the rigidity may involve the whole length, including the internal os. In rare cases it is difficult to overcome. Thus I have been compelled from this cause to deliver with the cephalotribe in labour premature at the sixth month. With rigidity may be associated œdema of the hypertrophied cervix, whereby the obstruction is increased.

In rare cases failure of dilatation may depend, not upon any widespread induration, but on primary smallness of the external os, associated with some rigidity of its edge. Since the resistance of the rim of the os to dilatation is inversely proportioned to its diameter (see p. 152), it is evident that a very minute os will offer great resistance to expansion by the longitudinal muscular fibres, and will entirely prevent any projection of the bag of membranes into it to form a dilator. In one such case, after labour pains had lasted for a week, I found the os with difficulty to be detected. First a small catheter, then the little finger, and next the index and middle fingers were got into it in quick succession. Spontaneous dilatation then went on rapidly, and labour was completed within a very few hours; but the child was still-born, apparently from the effect of the prolonged first-stage uterine contractions.

Diagnosis.—When the os has a thin, hard, undilatable edge, it may be expected that the dilatation stage will be prolonged. This condition is commonest in primiparæ, and probably depends more upon initial rigidity of tissue than upon spasm. In other cases the edge of the os is found rigid, although thick, especially in parous women, who have had hyperplasia of the cervix. It may be inferred with probability that spasm is an important element in the case when the pains are ineffective in producing tension of the bag of membranes, or pressure upon the os of the presenting part after the membranes have ruptured, especially if they are at the same time irregular or unusually distressing. Deficiency in the natural lubricating secretion, which is regulated by nerve influence, supports the same conclusion. Hyperplasia of the cervix in parous women may be revealed by its irregularity, and may be associated with a history of uterine symptoms before pregnancy.

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* For a discussion of the causation of this elongation with hyperplasia, see the author's "Student's Guide to the Diseases of Women."

Treatment.—In general, treatment has to be decided upon without absolute knowledge how much of the resistance is due to spasm, and how much to organic rigidity. For moderate rigidity in the early stage, with the membranes unruptured, and so long as no serious constitutional disturbance is produced, time and patience are the best remedies, as for deficiency of the pains. Interference by any manipulation at too early a stage runs the risk of making matters worse by increasing the irritation. The plan previously mentioned (see p. 445), of making sure that the membranes are not adherent around the os, may, however, be carried out. There is one safe treatment which may be adopted without fear, namely, the use at intervals of the vaginal douche with a large supply of hot water, which should have been sterilised by boiling, at a temperature of 105°—110° F. This is advantageous in stimulating the pains, as well as in relaxing the os. For the latter purpose a hot hip-bath, or, better, whole bath may also be used, but is often not so conveniently available. If contractions are unduly painful, chloral should be administered as already described (see p. 225), and often has the effect of making the pains more regular

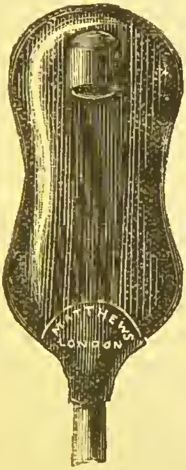

Fig. 155.—Barnes' hydrostatic dilator.

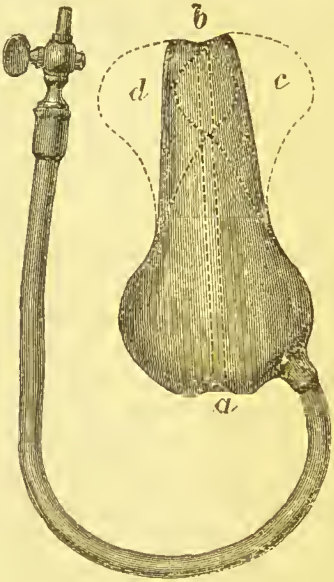

Fig. 156.—Improved hydrostatic dilator for cervix uteri.
a b, tube into which the introducer is passed, closed at the upper end *b*. The dotted outline shows the shape of the bag when expanded. For introduction, the corners *c d* are folded inwards.

and effective. For an extreme degree of this condition, however, especially when the membranes have ruptured prematurely, and the os remains rigid, notwithstanding frequent pains, chloroform is far more effective than chloral, and has also the advantage that the effect passes off more quickly when the desired result is sufficiently attained.

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Artificial dilatation.—Artificial dilatation should be undertaken if there is long protraction of the first stage after rupture of the membranes, and even before the rupture of the membranes, if the general condition of the patient calls for it, or if there is evidence of undue retraction of the uterus. It is to be remembered, however, that, in the first stage, when pains are frequent, the pulse is often more accelerated without serious import than in the second stage, when intermissions are longer.

Hydrostatic dilators.—The chief means of artificial dilatation, in the earlier stage, are the use of hydrostatic dilators and manual dilatation. Of these the former method is usually to be preferred when practicable, since it imitates more closely the natural mode of dilatation by the fluid wedge of the liquor amnii. The fiddle-shaped dilating bag introduced by Dr. Barnes is shown in Fig. 155, p. 455. When the bag is in place, the os uteri should embrace the constricted part of the bag, and the expanded portion above prevents the bag from being expelled. The shape of the bag, as sold, is often faulty, from the upper expansion not being wide enough, and this is often the reason why the bag cannot be got to remain in place. The bag is to be introduced by means of the cup in front (see Fig. 155), and it is generally recommended to use the uterine sound as an introducer, placing the tip of it in the cup. The sound, however, sometimes pierces the cup, if there is much resistance, especially if the bag happens to be an old one, and softened by use. It is better to use a metallic bougie of larger size, or a large gum-elastic catheter having a long stilette.

A modified hydrostatic dilator, much easier to introduce than the original form, is shown in Fig. 156, p. 455. The corners are doubled inward when the bag is in the undilated state, so that the upper end of it is conical and slips easily through the os, and the introducer passes through the centre of the bag, instead of being fixed in a cup outside. One of the thick metallic bougies, used for dilatation of the cervix uteri, answers best as an introducer, but the ordinary uterine sound may be used. The tube attached to the bag should have a stopcock. The bags are made of several sizes, to be used at different stages of dilatation. For introduction of the bag the patient may be placed in the left lateral position, the left hand or half hand passed into the vagina—if the vagina is capacious enough—and one or two fingers placed just within the posterior margin of the os, The bag is then guided up the flexor surface of the fingers, and passed up between the presenting part and the posterior uterine wall till it is nearly half-way through the cervix. If a Barnes bag of the original form is used, and has to be passed through a narrow cervix, the introduction is facilitated by tying the top of it round the introducer in the following way:—Take a piece of wet tape, tie it in a single knot round the bag, about half an inch from the top, the bag being held on the introducer by an assistant, the top directed towards the operator's chest, but instead of drawing completely through the end of the tape, draw it through only in a loop. Tie a knot on the free end of the tape corresponding to this loop, to distinguish it from the other. Traction on this end, which is to be left outside the vulva, will then at any time untie the knot, and meanwhile the wetness of the tape prevents its slipping. As soon as the bag is in place the tape can be loosened, and drawn away before the bag is dilated.

The lower end of the tube by which the bag is filled should be so adjusted as to fit on to the nozzle of the Higginson's syringe. Before any bag is introduced, it is well to measure by trial how many syringefuls of water it will hold without over-stretching the india-rubber. If this be not known, the bag is apt to be overstretched, and possibly may burst, letting the water escape into the uterus. As soon as the bag is in place, the same number of syringefuls of warm water is to be pumped in, or anything short of this number which will make the lower part of the bag sufficiently tense. If possible the lower end of the bag should be kept well backwards, so that the posterior vaginal wall may support it, and prevent its being so easily squeezed out into the vagina by the uterine action. The bag when in place, as well as being a mechanical dilator of the cervix, is a powerful stimulant to expulsive pains when these are deficient. The position of the bag should be noted from time to time, and it should not generally be left in place more than about an hour without removal, to note the progress made. If the bag is expelled by the uterus wholly into the vagina, it will frequently be found that it has already done its work, and that a larger size can be introduced. The only drawback to the use of the hydrostatic dilator is that, by pushing up the head, especially after escape of the liquor amnii, it may possibly promote displacement of the head from the brim, and descent of the hand, arm, or shoulder. On the removal of any bag, therefore, it should be noted whether the presentation remains undisturbed. If the head has been pushed to one side, it can generally be replaced easily by external or bimanual manipulation (see Chapter XXXIV.).

A new form of hydrostatic dilator has been introduced by

Champetier de Ribes, Fig. 157. This embodies two principles: (1), the bag is made of *inelastic* material; (2), it is about the size of a fœtal head, and therefore, when fully distended, cannot be expelled without dilating the cervix sufficiently. This can be introduced if the index and middle fingers can be passed as far as their first articulation. All air is to be expelled from the bag. It is then folded and placed between the jaws of the forceps, the distal end of the bag projecting some centimetres beyond the end of the forceps, and all freely lubricated with carbolised vaseline. The tips of two fingers being inserted within the cervix, the bag is

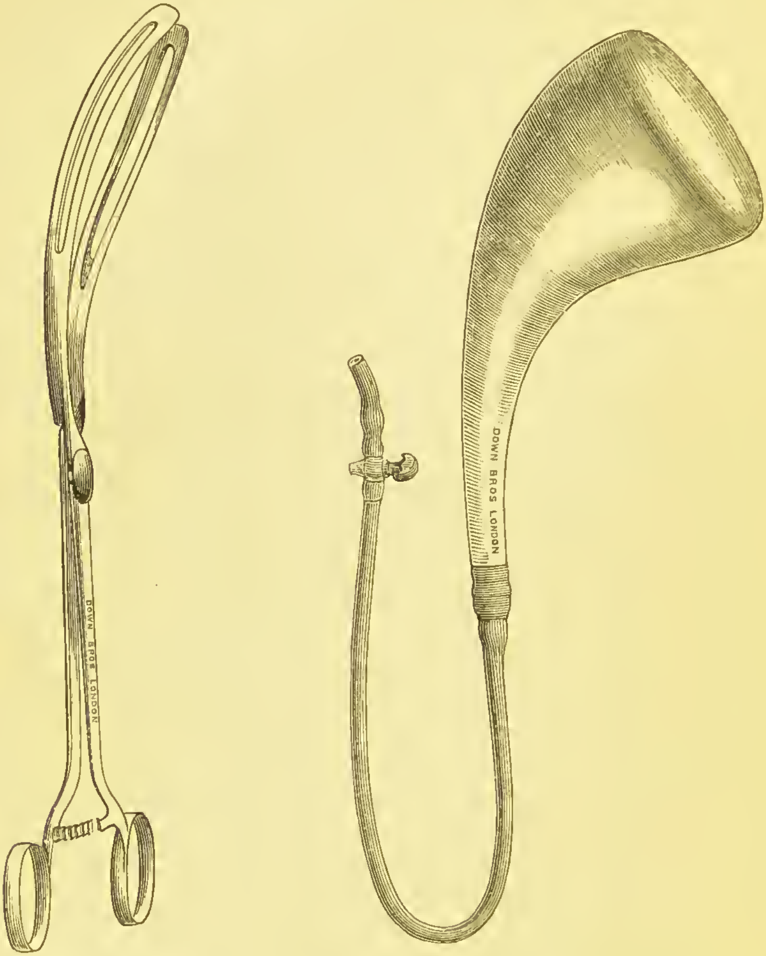

Fig. 157.—Champetier de Ribes' hydrostatic dilator, with forceps for introduction.

passed in between them. First one finger and then the other is withdrawn and the bag passed on until it penetrates 10–12 centimetres (4–4¾ inches) within the internal os. The bag is then filled by an assistant with 1 per cent. carbolic solution, while the operator with one hand holds the forceps, with the other feels what is going on at the level of the internal os. Meanwhile the forceps are opened, but not removed until the bag is dilated to such a size as will not admit of its descent. A syringe of about 6℥ capacity is used for filling the bag. According to the inventor, to fill the bag completely, and give it a circumference of 33 cm. (13 inches), 640 grammes (22·4℥) must be injected; if 540 grammes (18·9℥) be injected, the circumference will be 27 cm. (10·6 inches); if 440 grammes (15·4℥) be injected, the circumference will be 22 cm. (8·7 inches). When the bag is filled the operator ties a tape round the tube, so as not to be entirely dependent upon the stopcock. An antiseptic vaginal douche is then given, and repeated frequently during the course of labour.

The inelastic material of this bag appears to be an improvement, and the bag is much less easily displaced than Barnes' dilator. Its large size, however, increases the chance that it may allow some other part to descend by displacing the head: and in some cases, may make it difficult to find room for it within the uterus.

Manual dilatation.—There are certain cases in which the hydrostatic dilators are inapplicable, namely, when, after rupture of the membranes, the head is pressed so firmly down upon the os that the bag cannot be introduced without too great force, and also when the uterus is acting so powerfully that the bag is squeezed out immediately after introduction. It is chiefly in the later stages of dilatation that these difficulties are likely to arise. Under these circumstances, or when hydrostatic dilators are not at hand, manual dilatation is very efficacious, and it is even preferred by some authorities under all conditions, because the dilator itself is sentient, and can estimate the degree of tension exercised. The left hand may be used, the patient being in the left lateral position, or either hand when she lies on the back. The half-hand is introduced into the vagina, and two fingers are hooked into the os, drawing it somewhat forward. The tips of the fingers are then gradually introduced in the form of a cone, until four fingers can be passed in side by side. When the os has reached this size, dilatation can still be carried on by separating the fingers, but this soon fatigues the muscles. Dilatation can be carried on longer and more steadily if the whole hand is now introduced into the vagina, and the wedge which it forms enlarged by addition of the thumb, until the os will admit the full breadth of the hand. For this manipulation, chloroform is not generally indispensable, but it may be used with advantage if the resistance is probably due to spasm of the os, or if the patient is over-sensitive to pain. When the os is large enough to admit the width of the hand, the presenting part will generally be able to enter it deeply and complete the dilatation through the natural powers. Even in this latest stage, however, digital manipulation may assist, if the anterior lip of the cervix is driven down deeply in the pelvis, in front of the head. During each pain the fingers may be placed on the margin of the os nearest to the posterior fontanelle, so as to retract it until it slips over the occiput, which is naturally the part of the edge to emerge first.

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f. Cervix
drawn
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Application of forceps.—After dilatation has been carried as far as is possible by hydrostatic dilators or manual dilatation, the means most available for hastening delivery, if necessary, is the application of forceps. This means, however, should never be adopted merely to shorten the patient's suffering, or save the practitioner's time, but only when the rising pulse or other general symptoms due to protracted labour indicate the necessity for interference. Even then it is well first to employ full manual dilatation with the aid of chloroform, and then wait a short time to see what nature will effect. It will then be found to be only very rarely that the use of forceps is called for on account of the resistance of the os alone. The case has carefully to be distinguished in which, on account of disproportion between the fœtus and the pelvis, the head is prevented from fully entering the os as a dilator, though the os itself is dilatable. A comparatively early application of forceps is then desirable.

The contrary practice, namely, the comparatively frequent use of forceps before full dilatation of the os, has been recommended by some authorities, especially by Dr. G. Johnston, as master of the Rotunda Hospital, Dublin. Dr. Johnston invented a special form of forceps with narrow blades, in order to be able to pass them through a comparatively undilated os. In his last four years of office, with a total forceps-rate of 116·4 per 1000, he applied forceps in more than one-fourth of the cases (or at the rate of more than 29 per 1000, a rate about six times as great as the total forceps-rate in the Guy's Hospital Lying-in Charity, 1863–1875), before full dilatation of the os. Of these, the head was at or above the brim in considerably more than half, and, in more than a third, the os was less than two-fifths dilated. As already mentioned (see p. 450), Dr. Johnston's results do not show any material gain in the rate of still-births, and they certainly do not show that such a practice is safe for the mothers, even in such skilled hands as his. The maternal death-rate (1871–1875) was 19·3 per 1000, a very high one. This may, indeed, have been due to the septic risks in a lying-in hospital, before the introduction of the latest improvements in antiseptic midwifery. But in 88 cases, during the three years, 1872–1874, in which forceps were applied before full dilatation of the os, simply on account of premature rupture of the membranes—excluding all cases of complication, such as eclampsia, hæmorrhage, or prolapse of funis, and excluding also cases of disproportion—there were four deaths, *i.e.*, a death-rate of 46·6 per 1000. It would hardly have been anticipated that the increased risk from premature rupture of the membranes, without any other difficulty or complication, would have led to so great a mortality, if the cases had been left to nature, or treated merely by other modes of dilatation. Again, taking into consideration the whole number of forceps cases, the forceps-rate, which, under Dr. Shekleton (1847–1854), was 16·5 per 1000, rose under Dr. Johnston (1871–1875) to 116·4 per 1000. But the mortality after use of forceps per 1000 deliveries rose from 0·43 to 6·2, or in more than double the proportion. Again, the deaths per 1000 in the forceps cases themselves were, under Dr. Johnston (1871–1875), 54·4, while, under Dr. Shekleton, although the use of forceps was reserved for much more extreme cases, they were only 35·7.

The conclusion therefore remains undisturbed that forceps should never be applied until the os allows the easy application of the ordinary form of instrument. The os can always be expanded up to this point by manual dilatation. Whenever forceps are applied when the head is still within the uterus, and a rim of the cervix remains over the head, whether the cause of delay lies in the cervix or in any other condition, extraction should be carried out with extreme care and slowness, in order to give the cervix time to yield, and avoid, as far as possible, the risk of laceration.

Incision of the cervix.—It is not desirable to incise the cervix so long as there is hope of overcoming the difficulty by dilatation. since incisions, like spontaneous lacerations, by laying open the cellular tissues, expose to the risk of septic absorption, and the incisions are apt to be extended by lacerations. If, however, other means fail, and the condition of the patient demands interference, the edge of the cervix may be incised at three or four places, to not more than half an inch in depth. The incisions may be made with Kuchenmeister's scissors (designed for incising the unimpregnated cervix), or with ordinary scissors, or with a blunt-pointed bistoury, having only about half an inch of cutting edge exposed, and guided up to the resisting edge by the finger. The method of incision is most applicable when the difficulty is due to organic induration or cicatricial tissue, not extending far beyond the edge of the cervix.

Version or craniotomy.—It will only be in extremely rare cases that the resistance of the os leads to such grave risks to the mother as to justify sacrifice of the child, or even the increased danger to it involved by version. When the mother is in great danger from other causes, as from eclampsia, and the os will not yield, or when there are very strong grounds for believing the child to be already dead, either version or craniotomy, according to the condition of the uterus, may be called for.

ATRESIA OF THE CERVIX.—The cervix must of course have been permeable for pregnancy to occur. In some cases, however, no opening has been discoverable at the onset of labour. Adhesion of inflammatory granulations may have been formed after conception, sometimes as a result of the too vigorous application of caustics in the treatment of cervical inflammation, or of attempts to procure abortion. Care must be taken to reach every part of the vagina and cervix, before it is assumed that there is no opening, lest the case be really one of malposition of the os.

Treatment.—When labour pains have commenced, a puncture or incision must be made at the site of the os, or at the centre of the lower segment of the uterus, if the site cannot be discovered. Dilatation is then to be carried on by metallic bougies, dressing forceps, fingers, hydrostatic bags, or other convenient means, until there is space for the bag of membranes to bulge into the opening, and continue the dilatation.

MALPOSITION OF THE OS.—It has already been mentioned that the result of retroversion in the early months is supposed to be in some cases, the displacement of the os forward at full term, so that it lies out of reach, or nearly so, behind, and even above, the symphysis pubis (see p. 344). Other authorities attribute the same condition to a sacciform development of the posterior uterine wall. Similarly the os may be displaced backwards, opposite the promontory of the sacrum. Whatever the cause be of this condition, the result is the same. The os is unfavourably placed for dilatation by the muscular fibres, or for projection of the bag of membranes into it. The presenting part cannot enter it at all, for it lies in the cul-de-sac which forms the lower extremity of the uterus. Especially if the liquor amnii has escaped does the mechanism of dilatation fail altogether, and labour may be indefinitely prolonged.

Treatment.—If a hydrostatic dilator can be introduced into the os, this means may be employed. As the os becomes dilated, it will tend to approximate toward the axis of the uterus. In general the best plan is to hook the finger into the lower margin of the displaced os, and to stretch it by drawing it toward the central axis of the pelvis. Chloroform should be administered, if necessary, and a hydrostatic dilator may be used at a later stage. If the head lies in the lower cul-de-sac, and cannot be got to enter the os when fair dilatation has been attained, delivery by version may be necessary.

CICATRICES AND ATRESIA OF THE VAGINA AND VULVA.—Cicatrices of the vagina are most frequently the result of sloughing after protracted labour in former pregnancies. Some of the most severe forms arise in conjunction with vesico-vaginal or recto-vaginal fistulæ. Cicatrices may also result from syphilitic deposits, or from local injuries or operations apart from parturition. Sometimes there is an almost complete atresia from a congenital transverse vaginal septum above the level of the hymen, or the hymen itself may have a small orifice, and may have been so tough as not to yield in coitus. Cicatrices which involve deeply the surrounding cellular tissue are serious in their effects. They may be so resisting that the fœtus cannot pass without such lacerations as to lay open cellular tissue extensively, and involve the risk of subsequent septic absorption. Similarly, existing fistulæ may be increased in extent.

Treatment.—If there is any congenital septum, the aperture should be dilated by bougies, tents, or hydrostatic dilators. Or, if thin, the septum may be incised. In the case of cicatrices, fair time should be allowed to see the effect of the natural forces, and the softening associated with parturition. If necessary, the most resisting transverse bands should be incised with scissors or a blunt-pointed bistoury. The tissues may then be further stretched with the fingers, or the head allowed to continue the stretching. In some cases, extraction by forceps or after craniotomy may be required, cicatricial bands being divided further, as may be necessary, during the extraction. It has even proved necessary to perform Cæsarian section,* if the cicatricial tissue fills up the pelvis. This, however, is not likely to be the case, if artificial dilatation is commenced at a sufficiently early stage. If the cicatrices form an almost complete vaginal atresia, it may be necessary to commence the dilatation with laminaria tents.

RIGIDITY OF THE PERINEUM.—Rigidity of the vaginal outlet and perineum is a very frequent cause of delay in the latter part of the second stage of labour in primiparæ, especially if the uterus is then becoming fatigued. Both the difficulty and the risk of rupture are increased if the pubic arch is narrower than usual, so that the head is thrown more backward upon the perineum. Difficulty may arise even in subsequent labours, if the perineum has been repaired after rupture on a previous occasion, if cicatricial tissue has remained after previous rupture, or if the child is larger than former children have been.

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* See a case by the author, Obstet. Trans., Vol. XVIII.

Treatment.—Digital manipulations are often of value in aiding the dilatation of the perineum and avoiding rupture. While the head is retarded during a pain, in the mode already described (p. 215), if there appears to be danger of rupture, the index and middle fingers may be used to retract the perineum and gradually stretch it, in the intervals of pains. This can be carried out more effectually if chloroform is being administered during the labour. Hot fomentations, frequently renewed, may also be used when the head begins to distend the outlet. Within moderate limits, delay at this stage is conservative, giving the structures time to stretch under the influence of successive pains, and it is often desirable, while observing the tension placed upon the perineum, rather to delay the advance of the head than to hasten it. If delay is too great, or constitutional symptoms are arising, delivery must be effected by forceps. Though it is probable that, in actual practice, perineal rupture is more frequently caused than avoided by the use of forceps, yet this will not be the case if forceps are not applied prematurely, and the extraction is made with sufficient patience and slowness. For the force is not, like the natural expulsive force, inclined backwards in reference to the axis of the outlet, so as to press needlessly upon the perineum, and it may be made more gradual than the effect of the pains of the final stage of delivery. When there appears to be great risk of rupture, the extraction should be made by continuous steady traction in the *interval* of pains, the finger being kept all the while upon the edge of the perineum, to estimate its tension. Unless the patient's self-control can be thoroughly relied upon, it is well to keep her pretty fully under the influence of chloroform, that she may not make a sudden movement. The plan recommended by some, namely, to perform *episeiotomy*, that is, to make two lateral incisions in the edge of the perineum, in order to avoid a central laceration, is not generally desirable. For it is never possible to be certain when, and to what extent, a laceration is inevitable. And the clean cut laceration itself will almost invariably unite, if properly closed by sutures. In rare cases only, in which a laceration through the sphincter ani appears to be otherwise inevitable, this operation is advantageous.

Cancer of the Cervix Uteri and Pelvis.—Not very unfrequently, conception occurs notwithstanding the existence of cancer of the cervix uteri in its earlier stage. When this is the case, the stimulus of pregnancy generally causes a rapid growth of the cancer, so that when full term is reached, the disease may have reached to a very formidable extent, even involving the whole circuit of the cervix, and extensively infiltrating the cellular tissue around. In other cases cancer of the vagina, or cancer commencing elsewhere in the pelvis, as from the rectum, forms such a mass in the cellular tissue that the passage of the fœtus, even after embryotomy, becomes difficult or impossible.

Results.—In some cases, relief is brought by nature through the occurrence of spontaneous abortion or premature labour. If pregnancy goes on to the later months, the complication is very formidable. The difficulty in parturition depends not only upon the extent of growth, but still more upon its hardness. A certain amount of the softening of parturition may take place even in the diseased cervix: spontaneous lacerations may give increased space, and sometimes even unassisted delivery takes place with less difficulty than had been anticipated. If some part of the cervix remains free, it is generally possible to get sufficient dilatation to deliver the fœtus by some means, and, even when the whole circuit is involved, this sometimes proves possible, provided that there is not too much infiltration of the cellular tissue around with hard growth, and that the growth itself does not form too large a mass to allow the fœtus to pass.

The danger, however, is by no means over with delivery. Decomposition and inflammation or sloughing of the bruised cancerous tissue is apt to follow, and the most frequent cause of death is septicæmia set up in this manner. When the whole circuit of the cervix is so involved in the disease that no commencement of dilatation can occur spontaneously, the uterus sometimes passes into the state of continuous action without the occurrence of any distinct rhythmical pains. The pulse rises therewith, and the general condition becomes serious. In other very rare cases, when the uterus has remained quiescent, the fœtus has died, and been retained within the uterus beyond full term, thus constituting one form of the so-called "missed labour" (see p. 381). Sometimes before any onset of labour a condition of severe constitutional irritation, with elevation of pulse and temperature, and dry tongue, supervenes. This appears to be due to septic absorption from the cancerous discharge, and to be liable to be induced by any interference with the cervix, even by repeated digital examination. Some patients die undelivered from the effects of the disease, or after an abortive attempt at labour, or after fruitless attempts to deliver them. In others rupture of the uterus occurs (11 out of 180, Herman).

Prognosis.—Excluding cases in which abortion occurs, the mortality within the puerperal period in recorded cases is scarcely less than 50 per cent.* Even in cases in which labour terminates naturally without assistance, it is over 30 per cent. The mortality of the children is also very considerable, being about 38 per cent. This is not solely due to the effects of protracted labour, but partly to the tendency of the disease to bring on labour prematurely, and to the feeble vitality of the children, or their death in utero before labour, also the consequences of the disease.

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* For statistics of recorded cases, see Herman, "The Treatment of Pregnancy complicated by Cancerous Disease of the Genital Canal," Obstet. Trans., Vol. XX.

Treatment.—This is a case in which the interests of the mother have to be balanced against those of the child. Accordingly some authorities, considering that the mother must die before very long in any case, have considered that special regard ought to be paid to the life of the child. In this country it will be generally considered that the physician has not the right to sacrifice even a probable temporary prolongation of the mother's life for the sake of the unborn infant, especially since the preservation of a motherless infant is not always an unmixed advantage. It is only when the chances of the mother are very evenly balanced in the choice between two modes of treatment, as between craniotomy and Cæsarian section, when delivery is likely to be very difficult, that the consideration of the child's life may justly have some weight, especially if the parents are anxious for its preservation.

Induction of abortion.—Abortion should therefore be induced in the early months, if the patient comes then under observation, and the disease is too advanced for extirpation. The reason for this is not only that the risks after abortion are much less than after labour in the later months, but that the stimulus of pregnancy to the advance of the disease is thus abolished. Even in the later months there seems to be some gain in inducing premature labour, since the smaller size of the fœtus will render extraction more easy. Induction may be performed by puncture of the membranes, if this is practicable. If not, the cervix may be first dilated by a laminaria tent. In the first three or four months this will generally be necessary. Antiseptic precautions must be used with special strictness, on account of the risk of sepsis caused by pressure of a tent upon cancerous tissue.

Extirpation of growth.—If the disease is limited to the cervix, and the uterus is moveable, there is a choice between induction of abortion with subsequent extirpation of the disease or of the whole uterus, and immediate hysterectomy. The period immediately following an abortion, like the puerperal period, is an unfavourable time for operations; hence the former alternative involves a delay of two or three weeks at least in the removal of the cancer. Within the first three months of pregnancy, vaginal hysterectomy may be performed by the same method as in the case of the unimpregnated uterus, and this is the best treatment. If supra-vaginal amputation of the cervix is chosen in preference, it is better to induce abortion first.

In the later months a combined abdominal and vaginal method is necessary for hysterectomy. The modern success of *panhysterectomy* in the case of fibroid tumours justifies a skilful operator in performing this operation in preference to the induction of abortion. If the disease is at all widely spread over the cervix, the first step of the operation should in this case be carried out through the vagina, namely to separate the cervix from the vagina and strip it from the bladder. The pouch of Douglas may also be opened at this stage. Then abdominal section is performed, and ligatures placed on the broad ligaments, securing both ovarian arteries. Next an incision is made across the peritoneum above the bladder, the separation of the bladder is completed, and ligatures are placed securing the uterine arteries outside the wall of the uterus. Then the separation of the uterus is completed. The ligatures are left long and brought down through the vagina. The peritoneum at the back of the bladder may be stitched to that at the back of the pouch of Douglas, and a plug of iodoform gauze is placed in the vagina, and left untouched several days.

Management of labour.—Labour being induced, or coming on spontaneously, fair time should be allowed to nature to see what dilatation and softening of the cervix will take place before further interference is undertaken. Hydrostatic dilators have sometimes been used to stretch the cervix, but not with very favourable results. It seems that their prolonged pressure is more likely to cause inflammation of the growth or septic absorption than are lacerations or incisions.

Incision of the cervix.—In cases which end favourably by the natural powers, the yielding often takes place by spontaneous laceration. This may be imitated by artificial incisions with advantage, and the general results of cases so treated have been good. Hæmorrhage either from lacerations or incisions has not generally been very formidable. It may be arrested if necessary by swabbing with a solution of perchloride or subsulphate of iron. The method of incision is applicable chiefly when the disease is mainly in the cervix itself, not so much when there is a large hard mass in the cellular tissue outside. If there are projecting masses which are likely to slough afterwards, it will be of advantage to cut these away, and in this way more room may be gained. In one case of cancer involving the whole cervix, I incised in several directions up to the vaginal reflection, and then removed the intervening portions by the galvanic écraseur. Delivery followed very rapidly by the natural powers, the child being alive.

Forceps and version.—Delivery by forceps or version may be combined, if necessary, with the method of incisions, especially if the pains are not strong. Of the two, forceps give rather a more favourable chance to the child. Version, especially by the bipolar method, can be performed when the os is too small for application of forceps to be desirable, and the half breech then forms an efficient wedge-shaped dilator. In 9 cases delivered by forceps, there were 4 deaths; in 14 deliveries by version 8 deaths (Herman).

Craniotomy and Cæsarian section.—Before the introduction of Sänger's method of Cæsarian section, craniotomy and Cæsarian section both gave a very high mortality, one of from 70 to 80 per cent., with not very much to choose between them. With the improved method of Cæsarian section (see Chapter XXXVI.), the results are likely to be much improved, but not nearly equal to those obtained in cases of pelvic contraction, partly on account of the septic material produced by the cancer, partly on account of the depressed constitutional condition of the patient. Where the whole, or nearly the whole, circuit of the os is diseased, or much of the cellular tissue infiltrated, Cæsarian section gives the best chance, if undertaken as a primary choice. If attempts have already been made to extract by forceps or version, craniotomy is generally preferable.

Labour complicated by Tumours.

Myomata, or Fibroid Tumours of the Uterus.—Considering the frequency of fibroid tumours, it is comparatively rare for them to be met with as a complication of labour. In general, the presence of a fibroid appears to prevent pregnancy. It may also lead to abortion or premature labour. The dangers to which a fibroid tumour complicating labour may lead are inefficient or irregular contractions of the uterus, ante-partum, or more frequently post-partum, hæmorrhage—the latter depending upon the failure of the uterus to contract—obstruction to the passage of the fœtus when the tumour occupies the pelvis, sometimes rupture of the uterus from the combined effect of the obstruction and partial atrophy or weakness of the uterine muscle, and subsequent inflammation or sloughing of the growth from the effect of bruising or pressure, with consequent risk of septicæmia. Uterine contractions are apt to be unusually painful. A fibroid tumour also appears to predispose to placenta prævia, and may then render version or other treatment difficult, if the fibroid occupies the lower part of the uterus.

If the fibroids are corporeal and subserous, especially if pedunculated, generally labour is but little disturbed, unless their size is so great as to interfere with the action of auxiliary muscles. If they are interstitial, or submucous, the chief risk of hæmorrhage occurs, since the due contraction of the uterus is then apt to fail. If a fibroid obstructs labour by occupying the pelvis, it generally lies behind the cervix. It may then be either a corporeal sub-peritoneal fibroid which has dropped down into the pelvis, or a sub-peritoneal outgrowth from the cervix. The latter is much the more serious, since it cannot be pushed up out of the pelvis. Labour may also be obstructed by a large fibroid polypus, coming down in advance of the presenting part (see Fig. 158), by a sub-mucous fibroid in the lower part of the uterus or cervix, or by a general fibroid elongation and enlargement of the cervix, generally of the anterior lip. Fibroids generally enlarge with the stimulus of pregnancy, and they may at the

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Rupture of uterus
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Septicaemia

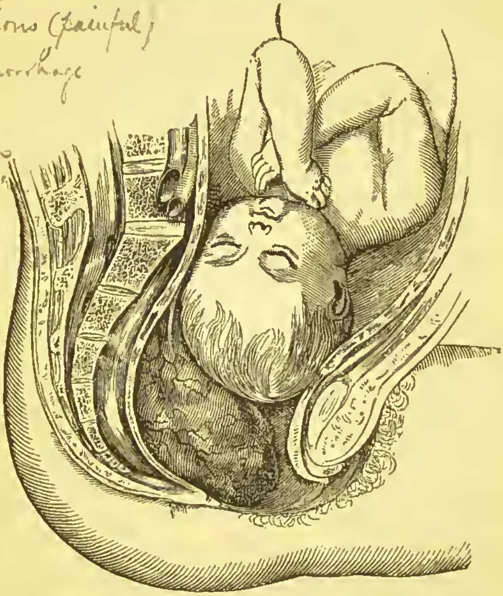

Fig. 158.—Labour impeded by uterine polypus.

same time become soft from œdema or cystic formation. In such case the growth may be difficult to distinguish from an ovarian tumour.

Treatment.—If the fibroids are corporeal, and do not occupy the pelvis, all that is generally necessary is to take special pains to secure due contraction of the uterus in the third stage of labour and afterwards. It is well to give a dose of ergot after delivery. If a subserous fibroid occupies the pelvis, so as to obstruct the passage of the fœtus, the first effort should be to push it up out of the pelvis. By this means the necessity for even Cæsarian section may sometimes be averted. The attempt may first be made with the patient in the knee-elbow position, with the fingers in the vagina, or, if that fails, in the rectum. If this also fails, an anæsthetic should be administered, and the attempt repeated with the patient in the semi-prone position. It is sometimes of service to introduce the half-hand into the rectum. If reposition fails, delivery may be effected by forceps or craniotomy according to circumstances. The latter operation will generally be required, and delivery through the flattened space is usually best effected by the cephalotribe. If extraction after craniotomy is likely to be difficult, that is to say, if the tumour does not leave a space in the pelvis measuring as much as $2\frac{1}{2}$ inches in its smallest diameter, and at least 4 inches in the diameter bisecting the former at right angles, it is better to resort at once to Cæsarian section. The results, however, are less favourable than in cases of contracted pelvis. But, besides saving the child, the operation has the advantage that the ovaries may be removed, in order to save the patient from the risk of future pregnancies, and cause shrinking of the tumour. Or, if the tumour is large, the whole uterus, with the tumour, may be removed by Porro's operation or panhysterectomy (see p. 466), the latter being the better if the tumour involves the cervix.

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If a case comes under observation before full term, a trial should be made whether the tumour can be pushed up out of the pelvis. If this is not the case, it is desirable to induce abortion or premature labour, if there is a prospect of delivery through the natural passages by this means. Care must be taken not to mistake the sac of an extra-uterine pregnancy, which generally lies behind the uterus, for a fibroid or ovarian tumour complicating uterine pregnancy.

Enucleation.—In the case of a submucous fibroid presenting at the lower part of the uterus below the fœtus, enucleation of the fibroid before delivery may be the best treatment, if delivery is likely to be otherwise very difficult. If there is any constriction at the lower margin of attachment, forming a demarcation between the tumour and the uterine wall, this may generally be effected. If the greatest diameter of the tumour can be made out as being larger than its base, a large écraseur may be used, and a loop of strong single steel wire passed over the tumour. Otherwise enucleation

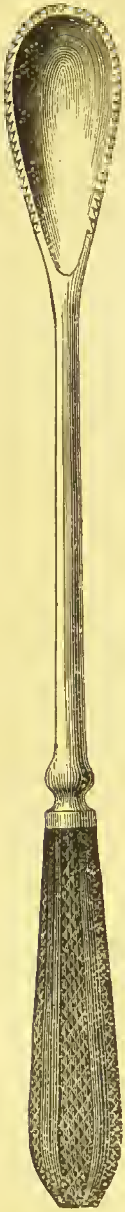

Fig. 159.—Thomas's serrated scoop for enucleating fibroids.

must be commenced from below. The mucous membrane may be incised with scissors along the lower margin of attachment, and the tumour then enucleated with the fingers or with Thomas's serrated scoop (Fig. 159). Traction upon the tumour, by means of strong tenaculum forceps fixed into it, will assist the operation. It is necessary for the safcty of this operation that there should be a sufficient thickness of uterine wall covering the tumour outside.

If fibroid enlargement of the anterior lip is likely to cause much obstruction, it may be amputated before delivery with the galvanic écraseur, if this instrument is available. A fibroid polypus is a much less formidable complication. It can easily be removed with the écraseur, or, in the absence of an écraseur, with scissors, before delivery. If a polypus is detected only after delivery, it should still be at once removed, lest sloughing should occur, and consequent septic absorption.

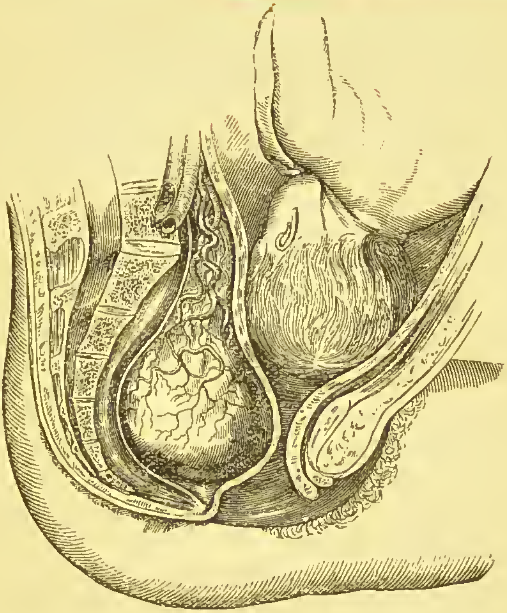

Fig. 160.—Labour impeded by ovarian tumour.

OVARIAN TUMOURS.—An ovarian tumour in the abdomen does not generally interfere with labour further than by making the pains less effective. Delivery by forceps may be called for on this account. If an ovarian tumour lies in the pelvis behind the cervix, it is liable to obstruct delivery like a fibroid in the same position (Fig. 160). It is still more likely than a fibroid, in consequence of the pressure to which it is subjected, to undergo inflammatory or necrotic processes afterwards, or to rupture into the peritoneal cavity. Of 57 recorded cases collected by Playfair,* 13, or 22·8 per cent., ended fatally.

Treatment.—As in the case of a fibroid tumour obstructing the pelvis, the best treatment is to push up the tumour out of the pelvis, either in labour, or during pregnancy if the case comes then under observation. Induction of abortion or premature labour may be indicated, if this cannot be done. If the tumour cannot be pushed up, it should be punctured through the vagina. This should be done even if it is apparently solid, and even if there is doubt whether it may not be a fibroid tumour of the uterus, for tenseness of fluid may give the impression of hardness, especially if a cyst has suppurated, and is surrounded with inflammatory products. For the puncture an aspirator may be used, with not too small a needle, lest the fluid prove to be thick and tenacious. The vagina should first be syringed with an antiseptic solution, and the aspirator needle sterilised by heat. In the case of a multilocular cyst, the needle may have to be passed in several directions, in order to secure the greatest amount of diminution. Even if the swelling is originally not large enough to be likely to render delivery impossible, yet, if it is of any considerable size, it is desirable to puncture it, if it appears to contain fluid, in order to diminish the risk of bruising and inflammatory change afterwards. If any considerable swelling remains after puncture, reposition may be again attempted with a better prospect of success.

In the case of a tumour mainly occupying the abdomen, but having a solid portion in the pelvis, tapping by the abdomen, instead of through the vagina, might be indicated. Under similar circumstances, ovariotomy might sometimes be the best treatment, if delivery were likely to be very difficult.

The greatest possible diminution of the tumour having been attained, delivery must be effected, if necessary, by forceps or craniotomy. In some cases it has been necessary to have recourse to Cæsarian section. In such a case, after the abdominal incision had been made, trial might be made first whether the tumour could be removed through the abdomen without opening the uterus.

HYDATID TUMOURS OF THE PELVIS are of rare occurrence in Britain, but may possibly form an obstruction of labour like an ovarian tumour. The nature of the tumour could hardly be diagnosed before puncture, unless from the presence of a similar tumour in connection with the liver, or in other parts. The obstruction caused by the tumour will generally be overcome by puncture.

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* Obstet. Trans., Vol. IX.

[illegible] (?) or Caesarian [illegible] Pelv[illegible]

CONGENITAL ABNORMALITY OF KIDNEY, in which the kidney is situated centrally in the lumbar region, has been recorded as a cause of obstruction to labour, and rupture of the uterus.

PROLAPSE OF THE VAGINA.—When the vagina has been prolapsed before pregnancy or during pregnancy, the hypertrophied tissue, especially the anterior vaginal wall, may be pushed down in front of the head, become œdematous from pressure, and cause a certain amount of obstruction. Sometimes a pouch of the bladder, forming a cystocele, descends with the vagina. If this contains urine, a tense swelling, causing increased obstruction, may be formed. The treatment is to empty the bladder by catheter, and retract the prolapsed mucous membrane with the fingers as the head is passing.

DISTENDED BLADDER.—Retention of urine, from pressure of the presenting part on the neck of the bladder, is not uncommon in labour. The top of the bladder rises in the abdomen with the lengthening of the cervix and upward travelling of the internal os uteri. If the abdomen be examined, therefore, a distended bladder is always easily recognised as an elastic fluctuating swelling in front of the lower part of the uterus. Its effect in rendering pains ineffective has already been considered (see p. 442). In passing a catheter it must be remembered that the meatus is often displaced forward by swelling and descent of the vaginal wall, and the urethra lengthened by stretching. The urine, moreover, is contained only in the upper part of the bladder. It is preferable, therefore, to use, not a short female catheter, but an elastic male catheter. If the catheter is arrested at the point where the head rests against the pubes, the head should be pushed up in an interval between pains, and the tip of the catheter guided forward by the finger in the vagina so as to pass the head.

VESICAL CALCULUS.—Calculus is very rare in women, and still rarer as a complication of labour. Cases have, however, been recorded in which a calculus has become impacted between the descending head and the pubes, or fixed at the entrance of the urethra, and formed an obstacle to labour. The diagnosis, if any doubt existed, would be at once decided by the use of the bladder sound.

Treatment.—The calculus should, if possible, be pushed out of the way above the pubes. The elevation of the bladder in labour will generally facilitate this. If it does not otherwise succeed, the attempt should be repeated in the knee-elbow position, the head being pushed backward. If the calculus is firmly impacted and cannot be pushed up, it may be extracted after rapid dilatation of the urethra, if small. If it is large, vaginal lithotomy may be

[illegible]

performed, if necessary, by a longitudinal incision, and the wound closed by sutures when delivery is completed.

VAGINAL ENTEROCELE.—Prolapse of the posterior vaginal wall, independent of pregnancy, is often accompanied by rectocele. Much more rarely some portion of the small intestine, omentum, or some part of the large intestine, as the sigmoid flexure, descends into the pouch of Douglas, which is always drawn down into the swelling (Fig. 161). Thus a kind of vaginal hernia is formed. In rare cases, such an enterocele may be pushed down in front of the head in labour, and its return prevented by the pressure. Such a swelling will be resonant, with gurgling on pressure. The diagnosis will be made certain by combined vaginal and rectal examination. The treatment is to return the hernia by pressure, with the aid, if necessary, of the knee-elbow position, the head being pushed backward. If this does not succeed, the attempt may be made with the aid of chloroform, the patient being in the semi-prone position. This also failing, delivery may be hastened with forceps.

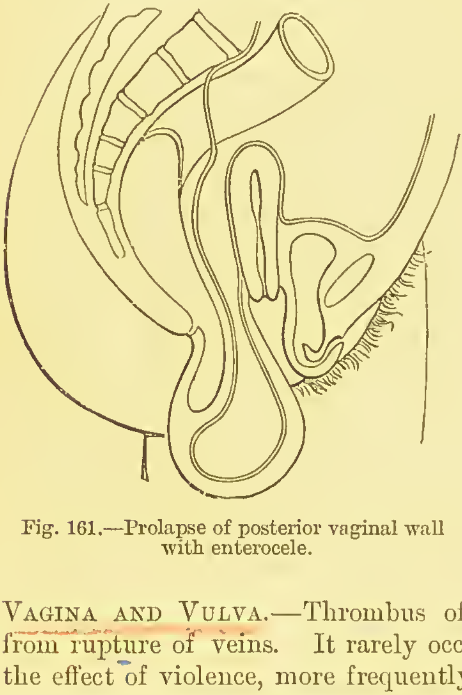

Fig. 161.—Prolapse of posterior vaginal wall with enterocele.

THROMBUS OF THE VAGINA AND VULVA.—Thrombus of the vagina or vulva arises from rupture of veins. It rarely occurs in pregnancy, unless from the effect of violence, more frequently in actual labour. The causes
1 are, first the vascular distension of pregnancy, next the obstacle to
2 venous return from pressure of the presenting part, and finally
3 the increased venous pressure due to the bearing-down efforts. In other cases the lesion of the vessels may be caused by the advance of the presenting part, more rarely by some operative interference. In some cases a tense swelling is produced large and hard enough to form an obstacle to delivery. In others the swelling is comparatively small, or only becomes manifest after delivery. The surface may rupture from tension or be lacerated in delivery, and then profuse hæmorrhage may occur, even to such an extent as to prove fatal. Afterwards there is danger of septicæmia from break-

ular distension of pregnancy
of presenting part

ing down of the effused clot, especially if exposed to the air. Most frequently the effusion commences close to the vaginal outlet on one side, and extends thence up the vagina, and outwards towards the labium. Occasionally the blood has extended to a much greater distance, as to the iliac fossa or beneath the abdominal wall.

Generally the swelling increases rapidly and is accompanied by acute tearing pain in the part affected, and extending to the thigh. Marked symptoms of anæmia may appear at the same time. If the lesion is caused by the head itself, the effusion may be kept in check by pressure, and only increases more gradually after delivery is completed. The swelling is tense but fluctuating, while the blood remains fluid, the surface dark blue and translucent. As clot forms the swelling becomes harder. The vagina may be so much narrowed as to impede the escape of the lochia. The surface may give way only after an interval of some days, and then there is danger of recurrent hæmorrhage. The suppuration which follows rupture or artificial opening may lead to necrosis of tissue round, or burrowing abscesses, as well as to septicæmia. In favourable cases resolution occurs without rupture.

Thrombus of vagina or vulva does not occur more than once in 2,000 or 3,000 deliveries. As a cause of obstruction to labour, it is very much more rare even than this. When the effusion is extensive, the prognosis is a rather serious one. In 67 cases collected by Winckel* there were 6 deaths, or 8·9 per cent., and other authorities have given a much more unfavourable estimate than this. Under favourable circumstances, however, the results may be better. Still more rare instances have been recorded of thrombus affecting, not the lower part of the vagina or vulva, but the tissue immediately surrounding the cervix.

Treatment.—If the commencing formation of a thrombus in labour is detected early, the fœtus should be extracted with forceps as quickly as possible, since the relief of venous obstruction is the best means to stop the bleeding. If the swelling is so large as to prevent delivery, it must be first incised. The bleeding may be stopped by pressure with absorbent cotton soaked in a solution of perchloride or subsulphate of iron and tucked into the opening, or by drawing the head quickly down upon the opening. Bleeding after delivery must be stopped in the same way by pressure with cotton soaked in a styptic. If the opening is within the vagina, pressure by a hydrostatic dilator filled with cold water may be added. This must be removed from time to time for the vagina to be syringed, and will not have to be continued more than about twelve hours. Dangerous bleeding may be kept in check by pressure with the finger alone, while the cotton soaked in iron solution is being prepared. Recurrent bleeding is to be treated in a similar way.

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* Pathologie und Therapie des Wochenbettes.

If the delivery is over, and the thrombus is not ruptured, it should be left unopened if possible. If it is found to be increasing in size, and is within the vagina, pressure may be made upon it for a time by the hydrostatic dilator filled with cold water. The thrombus should only be opened if the surface is becoming sloughy, if there are signs of suppuration in it, or general signs of septic absorption attributed to its presence, or again if the swelling is so enormous that there is no hope of its absorption. Even a delay of a few days in opening is an advantage, for there is then less risk of recurrent hæmorrhage. If an opening is made, it should be fairly free, and at a prominent yet dependent part, generally at the inner side of the labium majus. It is better not to attempt to detach clots from within, for fear of setting up fresh bleeding. If the thrombus has ruptured or been opened, the aperture should be frequently syringed with an antiseptic solution, and iodoform may be dusted into it. Any sloughy and loose bits of tissue should be removed.

Œdema of the Vulva. — In some cases, especially when albuminuria exists, œdema of the vulva may be so great as to form some hindrance to the exit of the fœtus, and to cause a risk of injury to the œdematous tissue through pressure. In such a case it is desirable, before the final stage of labour is reached, to let out the serum by making numerous punctures in the œdematous tissue.

CHAPTER XXVIII.

LABOUR OBSTRUCTED BY ANOMALIES OF THE OVUM.

SHOULDER, ARM, AND TRANSVERSE PRESENTATIONS.

ALTHOUGH the term "transverse presentation" or "crossbirth" is frequently used, it is very rare for the long axis of the fœtus to lie transversely in the uterus, either in pregnancy or at the onset of labour. Almost the only case in which the fœtus actually lies transversely is that in which the abdomen is so contracted from above downwards in consequence of spinal deformity that there is more room for the axis of the fœtus in a transverse than in its usual position. The shape of the uterus then accommodates itself to the necessity of the case. In the cases often called "transverse presentations," the axis of the fœtus for the most part really lies obliquely in the first instance, the head lower than the breech. The head is then displaced to one side of the brim instead of descending into it, and the shoulder becomes usually at first the presenting part. As the shoulder is pressed more deeply into the brim, the head is deflected more and more upwards, and the long axis of the child becomes more nearly transverse than at first. After the rupture of the membranes the arm frequently is prolapsed, and so becomes the presenting part (Fig. 162, p. 478), but the mechanism is not essentially different, whether the shoulder or arm present. More rarely other parts of the fœtus present, such as the back, or the abdomen, the fœtus in the latter case being in a position of excessive extension or opisthotonos, instead of the usual position of flexion. These presentations occur chiefly with a premature or macerated fœtus, which is apt to become doubled up in various positions. They have a tendency to become converted into shoulder presentations. In rare cases the so-called compound presentations occur, such as hands and feet together, or feet with head. In these cases the axis of the fœtus may have considerable obliquity or be nearly transverse, or it may be much doubled upon itself. The presentation of feet with head implies that the legs are extended upon the thighs instead of being flexed as usual.

In all these presentations the fœtus is moulded into such a shape that it forms a wedge with the base uppermost, the dimensions of the base being as a rule so large that it cannot possibly pass through the pelvis. In the case of shoulder or arm presentation the base of the wedge is formed by the diameter of the head in addition to that of the thorax. As a rule, therefore, delivery is impossible, except by artificial means.

Frequency.—The frequency of shoulder or transverse presentation in its different varieties has been estimated at from 1 in 130 to 1 in 250 cases. In the Guy's Hospital Charity it was 1 in 354, in 49,588 births.

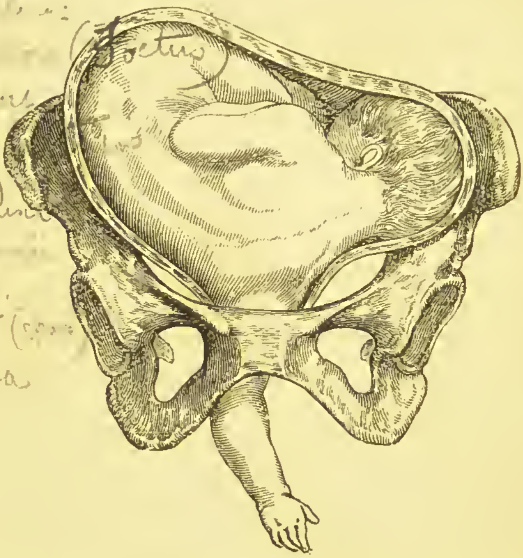

Fig. 162.—Arm-presentation in the dorso-anterior position.

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Causation.—All abnormal, and especially oblique and transverse, positions of the fœtus are relatively common in pregnancy before full term, and tend to become rectified by the mutual adaptation of the uterus and the fœtus, as previously described (see p. 100). Immaturity of the fœtus is therefore an important cause of shoulder presentations. Another is death or maceration of the fœtus, for then the tonicity by which it maintains its axis, and the muscular movements by which adaptations are aided, both fail. In the development of shoulder presentations out of a slightly oblique position of the long axis, contraction of the pelvic brim, especially contraction of the conjugate diameter, plays an important part.

For if the fœtal head is unable easily to enter the brim, it is more likely to be deflected to one side toward the iliac fossa. If on the other hand it can lie deeply in the pelvis before the onset of labour, its displacement is unlikely. Thus women who have a contracted pelvis are liable to have shoulder presentations recurring in successive labours. In conjunction with pelvic contraction sufficient to keep the head above the brim, obliquity of the uterus is an important cause. The uterine force being oblique tends to push the head toward the opposite iliac fossa. Thus the head lies more frequently in the left iliac fossa, and this fact is probably explained by the fundus uteri being generally oblique towards the right.

Other causes are those which act by interfering with the natural adaptation of the fœtus to the shape of the uterus through uterine contractions. These are laxity or weakness of the uterine muscle, excess of liquor amnii, twin pregnancy, and want of space in the abdomen due to spinal deformity. Laxity of the uterine muscle may be one reason for shoulder presentation being relatively common in multiparæ. Other reasons are that the uterus is more often oblique or anteverted, from diminished tone of abdominal walls, and that the head does not generally lie so low in the pelvis before labour, on account of the condition of the cervix. When liquor amnii is excessive, the uterine action has little effect in producing adaptation during pregnancy. If the fluid escapes gradually on rupture of the membranes, rectification may then be effected. If it escapes suddenly, the fœtus may become fixed in any abnormal position. In twin pregnancy, not only is the force of adaptation almost abolished, but one fœtus may displace the other by pressure. In placenta prævia also there is a greater tendency to shoulder presentation, when the mass of the placenta prevents the head from resting so low in the uterus during pregnancy.

Varieties.—Shoulder and transverse presentations are divided into two main varieties: dorso-anterior, in which the back of the child is directed forward (see Fig. 162, p. 478), and abdomino-anterior, in which the abdomen is directed forward (see Fig. 163, p. 480). Each of these again is divided into two varieties, according as the head lies in the right or the left iliac fossa. In most cases the back is not directed precisely backward or forward, but somewhat obliquely, as in the cranial positions out of which the shoulder presentations are developed. The relative frequency of the varieties of shoulder presentation is in accordance with that of the different positions of the vertex. Thus dorso-anterior positions are about twice as frequent as abdomino-anterior. The uterus being usually rotated somewhat to the right, the transverse or broadest diameter of the shoulders generally lies nearly in the right oblique diameter of the pelvis,

Dorso

abd

rather than exactly transversely. Hence the head generally lies somewhat more forward in the iliac fossa if it goes toward the left side than if it goes toward the right, being displaced laterally in reference to the shoulders. Prolapse of the funis is relatively common, the umbilicus being brought lower than normal, and the os not so well filled as by the head.

Diagnosis.—In the early stage of labour, the presenting part lies higher than usual, and may on that account be difficult to reach

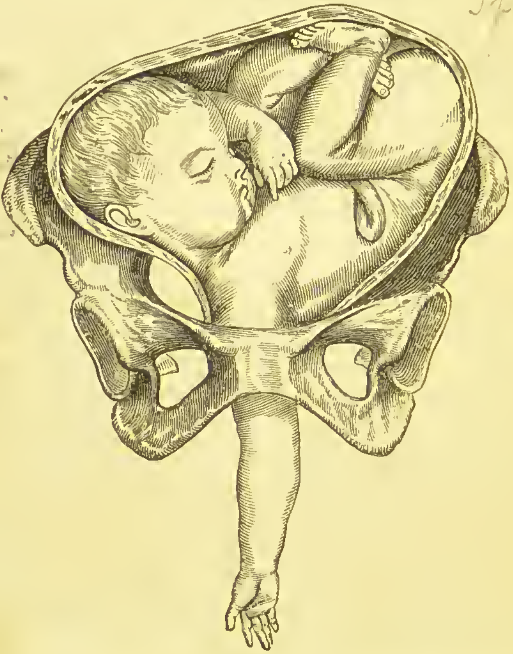

Fig. 163.—Arm-presentation in the abdomino-anterior position.

Spont
1) Rectificati
2) Version
3) Evolutio
(4) Exbulsi

or to make out; the bag of membranes forms a longer and less wide prominence than usual; and the labour often comes on slowly and insidiously, the os having less stimulus from pressure. After the rupture of the membranes, the pains may even appear to subside. This sometimes has the unfortunate result that the accoucheur is not sent for betimes.

Transverse or oblique positions of the fœtus can always be easily made out on abdominal palpation, provided that the uterus is lax and the abdominal walls not excessively thick from fat; and frequently the position can be easily changed by external pressure only. Instead of one broad firm portion of the fœtus—the breech, being felt toward the fundus, two firm portions—the breech and the head, are felt, and these are displaced towards opposite sides. The head generally lies in one or other iliac fossa. In all cases, therefore, in which the presentation cannot be made out on vaginal examination, or in which shoulder presentation is suspected, a careful abdominal examination should be made. If the membranes have been ruptured for some time, and the uterus has closed tightly round the fœtus, it is more difficult to make out the head distinctly through the hard uterine wall, especially if it lies rather backward.

It is of the greatest importance to make an early diagnosis in shoulder presentation, so that, if possible, the position may be rectified before the rupture of the membranes, and that, at any rate, this rectification may be carried out before the uterus has become closely contracted round the child, and version thus rendered difficult. If, therefore, the presentation cannot be made out with complete certainty by one or two fingers, the half hand or whole hand should be introduced into the vagina so as to reach high in the pelvis and settle any doubt. The examination should be made only in the absence of a pain and when the membranes are quite lax, lest these should be ruptured prematurely. If pains are frequent and vigorous, it is well to administer chloroform for the purpose. Otherwise the reflex stimulus caused by the hand may excite a violent pain, which ruptures the membranes.

The shoulder can hardly be mistaken for anything else except the breech, a mistake which I have known to be made with disastrous results. The distinctive points about the shoulder are the borders of the axilla, and especially the ribs below it, which are quite characteristic. The spine of the scapula and the clavicle will also be felt. On the other hand, the breech is positively diagnosed by the sacral spines and the anus. The direction of the axilla will give that of the body, and the head will therefore lie in the opposite direction. Indeed it can often be reached by the examining hand. The positions of the clavicle and spine of the scapula will show whether the back is directed forward or backward.

The elbow is distinguished from the knee by its being less broad, and having the sharp projection of the olecranon. As this distinction is not always quite easy, it is well, if the slightest doubt exists, and the membranes are already ruptured, to bring down the hand or foot, which can quite readily be distinguished. The measure is entirely free from any disadvantage in both cases.

The hand is distinguished from the foot by the length and mobility of the fingers, which often grasp the examining finger, and still more by the thumb, separated from the fingers, and the absence of the prominence of the heel. The most characteristic points about the foot are the projection of the heel and the malleoli of the ankle.

To distinguish whether right hand or left is presenting, place the fingers on the flexor surface of the hand as in shaking hands. If then the thumb is directed in the same way as the thumb of the examining hand, as it would be in shaking hands, the hand is the same, right or left, as the examining hand. The position of the fœtus may also be determined from that of the arm when prolapsed in the vagina, in the following way. Draw the arm gently downward, and hold it in a position of moderate (not excessive) supination. The palm of the hand will then look towards the abdomen, and the thumb towards the head. Any one may readily test the applicability of this rule by stretching out his own hand in a position of supination.

Prognosis.—The prognosis will depend upon the stage at which the malposition is detected and the skill of the treatment. Churchill estimated the mortality of the mothers as being as high as 1 in 9, and that of the children as 1 in 2. In the Guy's Hospital Lying-in Charity, in 49,588 births, there were 140 shoulder or transverse presentations, and among these three deaths, two from septicæmia, one from rupture of the uterus before assistance arrived. 70 per cent. of the children were stillborn, including the premature children.

Natural terminations.—Although, in the majority of cases, it is impossible for delivery to take place by the natural forces, yet to this rule there are the following exceptions.

Spontaneous rectification.—A change by which the oblique position of the fœtus is converted into a normal one, with the head presenting, is common during pregnancy, and may occur even during labour. As a general rule, but not invariably, it is necessary for its occurrence that the membranes should remain unbroken. The force which brings the head toward the uterine axis is the effect of the contraction of the circular muscular fibres. It has already been explained that the uterus, in contracting, no longer acts like a shapeless bag ; but tends to assume its own pear-shaped form ; and the relatively great strength of the contraction of the circular fibres is shown by the fact that normally the fœtal axis is lengthened, not shortened, during the pains (see page 166). Spontaneous rectification is promoted if the patient lies on the side *opposite* to that toward which the breech is deflected. For then the breech gravitates towards the middle line ; and therefore tends to bring the opposite fœtal pole—the head, also towards the middle line. Rectification is more likely to happen with a living child, for then the fœtal axis has greater tonicity, and also the movements of the child themselves promote adaptation. The relative frequency of spontaneous rectification cannot be estimated, for it may often have occurred in the first stage of labour, before an examination is made. In the Guy's Charity, out of 77 cases of shoulder and transverse presentations in the twelve years, 1863—1875, spontaneous rectification occurred in two, after rupture of the membranes and prolapse of the arm, the head coming down by the side of the arm, and the child being expelled without assistance.

Spontaneous version.—In spontaneous version the long axis of the fœtus is not brought into coincidence with the uterine axis by the shortest way, but is changed into a nearly reversed position. The breech is brought down towards the mother's pelvis, the shoulder recedes in the direction of the head. Eventually the head ascends towards the fundus, the breech becomes the presenting part, and the case is terminated like one of pelvic presentation. Unlike spontaneous rectification, spontaneous version generally occurs *after* the rupture of the membranes. As a rule, however, it implies that the shoulder has not descended very low into the pelvis, and that the uterus has not closed so tightly round the child as to prevent its having a fair mobility. In some recorded cases, however, it has occurred several hours after rupture of the membranes.

Spontaneous version is not so easily explained as spontaneous rectification, for the usual forces of adaptation would tend to produce the latter change only. For its production a vigorous but *unequal* contraction of the uterus appears to be the essential. The pressure of the breech stimulates that part of the uterus which covers it, especially the longitudinal fibres, to contract powerfully. The breech is thus forced down towards the pelvis, and at the same time a comparative laxity of the part of the uterus covering the head allows the head to rise, and the presenting shoulder to move in the direction of the head. As soon as the head has once risen above the level of the breech, the usual forces of adaptation will tend to complete the version, to bring the axis of the fœtus into coincidence with that of the uterus, and to make the breech the presenting part. It is clear that, for the descent of the breech to cause ascent of the head, the axis of the fœtus must have a certain degree of tonicity. Hence as a rule spontaneous version takes place with a living child only. It is possible also that the movements of the legs may have something to do in evoking the powerful unequal contraction which causes descent of the breech. By some authorities, what has been called spontaneous rectification is included as a variety under the title of spontaneous version, but the mechanism of the two processes is opposite in character. In the Guy's Hospital Charity spontaneous version occurred in 4 cases out of 77, living children being born by the breech.

Spontaneous evolution.—In spontaneous evolution the head remains neck

fixed in its original position without elevation, and a rotation of the fœtus takes place about the point where the neck is jammed against the pubes, aided by a doubling up of the body. The presenting arm with the shoulder is first driven deeply into the pelvis. Then more and more of the thorax is driven down beside and below the shoulder, the body becoming doubled upon itself. Some rotation of the longest diameter of the doubled fœtus into the antero-posterior diameter of the pelvis occurs at this time (Fig. 164), the prolapsed arm coming under the pubic arch, the breech into the hollow of the sacrum, the head remaining above the symphysis

up

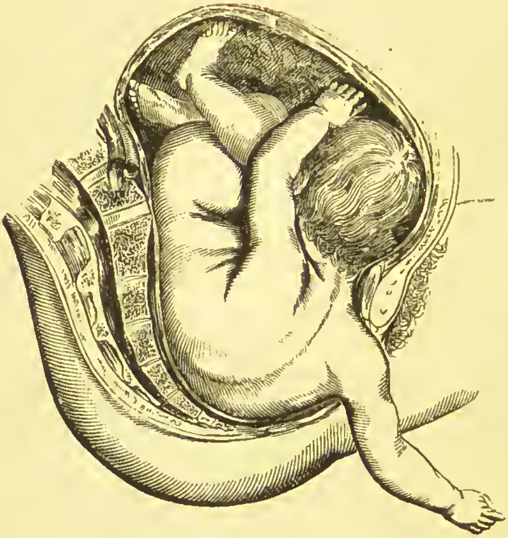

Fig. 164.—Commencement of spontaneous evolution.

pubis. The side presents first at the vulva behind the prolapsed arm, then, the shoulder remaining fixed, the breech is forced lower and lower until it is expelled, followed by the legs (Fig. 165, p. 485). Then comes the thorax with prolapsed arm, and finally the head, with the upper arm generally lying behind it (Fig. 166, p. 486). For spontaneous evolution to be possible the child must be premature, or moderately small relatively to the pelvis, and the pains vigorous. While spontaneous version generally requires the child to be alive, in spontaneous evolution it is almost invariably dead, first, because the doubling up of the body is greatly facilitated by the loss of tonicity which follows its death, and secondly because the child could hardly survive in such a position the enormous pressure required to cause the doubling up and expulsion. Out of

must be

vigorous

dead

77 cases in Guy's Hospital Charity, spontaneous evolution occurred in 6. Three of the children were premature, two were twin children, and one was decomposed. In two other cases spontaneous evolution appeared to have commenced, and was completed by artificial extraction. The eight children were all stillborn. It is of course possible that evolution might eventually occur in a larger proportion of cases, if version were not performed.

Spontaneous expulsion, or evolutio corpore conduplicato.—This is a much rarer event than the ordinary spontaneous evolution, and requires a still greater capacity of the pelvis in proportion to the size

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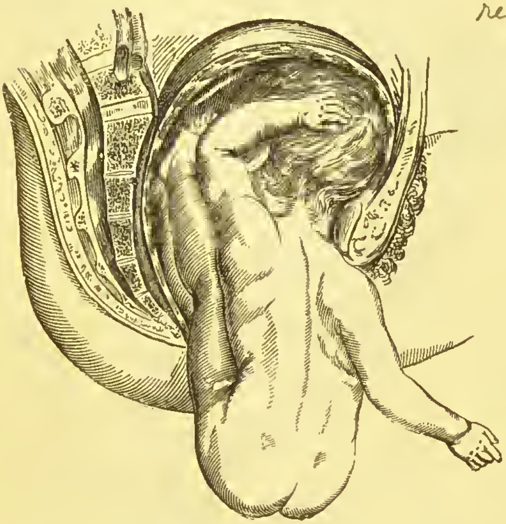

Fig. 165.—Further progress of spontaneous evolution.

the

of the fœtus. The capacity is, however, required only in one direction, and hence a contracted conjugate diameter is not necessarily an absolute obstacle. The mechanism is similar to that of spontaneous evolution up to the stage at which the doubled side has descended into the pelvis, and the head is doubled back upon the abdomen (Fig. 164, p. 484). Then, instead of remaining above the brim, the head enters the pelvis, pressed deeply into the abdomen, and the two pass together (Fig. 167, p. 487). The presenting shoulder emerges first, following the arm, then head and abdomen together, the head in advance of the breech, and finally the legs. This kind of evolution is promoted by traction upon the arm, the presenting shoulder here coming in advance. It occurs only with a dead fœtus, and generally one either premature or macerated. No instance of it occurred in 23,811 births in the Guy's Hospital

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Charity. In the case of abortions, before the child is viable, it is not so uncommon.

Termination of neglected cases.—After the rupture of the membranes, nearly the whole of the liquor amnii soon drains away, the presenting part not filling up the os closely. The uterus then contracts closely around the fœtus. Pains continuing, provided that the case is not terminated in any of the ways already described, retraction of the contractile portions of the uterus occurs (see p. 439), associated with great stretching of the cervix and lower distensible zone of the uterine body. This is apt to lead to rupture in the thinner portions of the uterus, or in the vagina. If rupture does not occur, the uterus eventually passes into the state of continuous action, and the other grave symptoms of obstructed labour supervene (see p. 438). The patient eventually sinks from exhaustion, or, if the uterus is inactive, from peritonitis and septic absorption after the death of the fœtus.

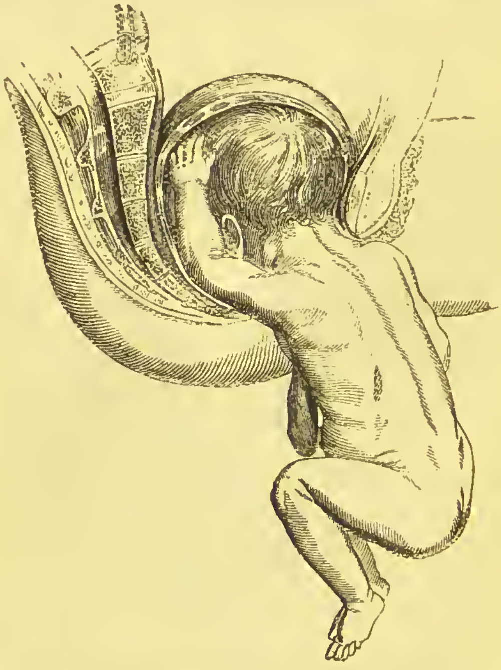

Fig. 166.—Termination of spontaneous evolution.

Treatment.—*Version.*—Treatment consists in rectification of the position of the fœtus by version, so as to bring either the head or the pelvis to present. This will be described in full in

Chapter XXXIV. The version is to be carried out in the mode which implies the least possible interference; if possible, before the rupture of the membranes, by external manipulation only; otherwise by bipolar version; if this also fails, as will generally be the

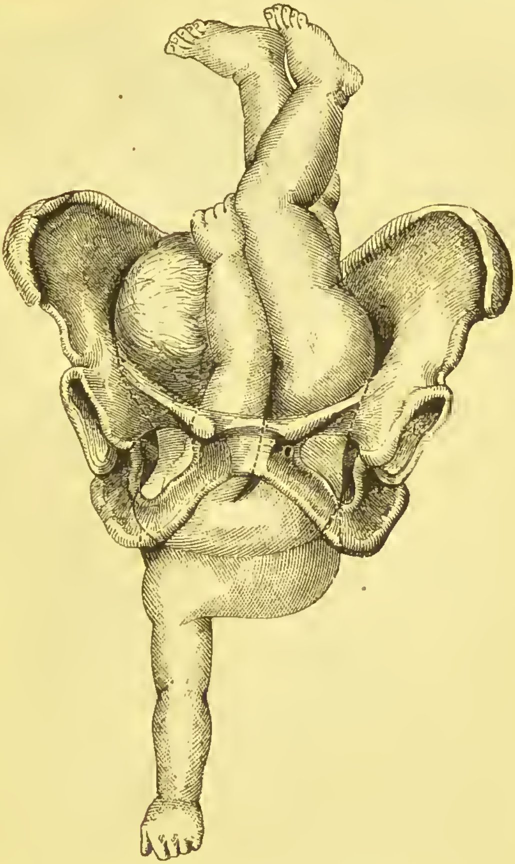

Fig. 167.—Spontaneous expulsion. (After Kleinwächter.)

case when the membranes have been ruptured some time, by the ordinary internal version.

Decapitation.—It is only in very rare and long-neglected cases that version will fail, in moderately skilful hands, if chloroform be given to the full surgical degree, and if the small blunt hook or noose be employed, if required, to make traction upon the knee or foot (see Chapter XXXIV.). I have never met with a case in which the knee or foot could not be reached. But it does sometimes happen, when the uterus is very firmly contracted around the child, as, for instance, when the liquor amnii has escaped for several days, that the fœtus cannot be got to revolve by any safe degree of traction upon the leg. It may even happen, with a decomposed fœtus, that the leg may separate, and come away. By far the best resource, if the neck can be reached, is then decapitation.

otham hook not
serrated (i.e. not sharp)

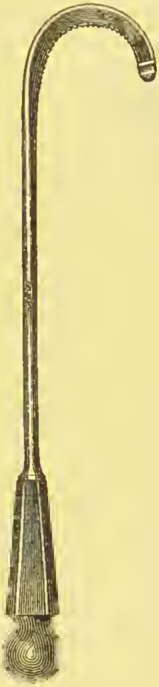

Fig. 168.—Decapitating hook, with serrated edge.

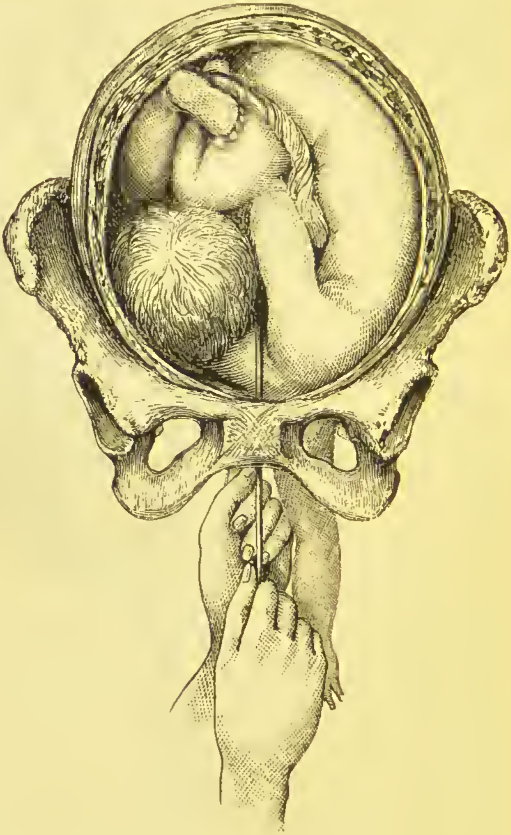

Fig. 169.—Decapitation.

Also, if there is strong evidence that the child is dead, decapitation may be performed in preference to exerting great force in attempting to effect version, lest rupture of the uterus should result. More especially, if the shoulder is driven down low in the vagina, the arm protruding externally, no attempt should be made at version, for the child is then certain to be dead, and version would be dangerous. The best instrument to decapitate with is a semicircular hook, with a saw edge (Fig. 168). Other modes of operating have been recommended, such as cutting upwards with blunt-pointed scissors, or the use of a sharp hook, semi-circular or sickle-shaped. Scissors are apt to wound the soft parts, or operator's fingers, and the operation with them is tedious and difficult. A sharp hook is apt to become blunted against the vertebræ, and then fail to divide the spinal column. With a saw-edged hook delivery can always be effected in a few minutes, if the hook is once placed over the neck. Another method, recommended by some authorities, is to use a strong wire écraseur for the amputation. The difficulty, however, of getting the wire-loop round the neck is much greater than that of getting the saw-edged hook into position.

The following, then, is the method to be adopted in decapitations :—Bring the shoulder as low as possible by traction upon the prolapsed arm. The neck can then generally be reached by the left hand passed into the vagina. Carry the decapitator, protected by the flexor surface of the fingers, up in front of the neck, passing it along the arm, the point directed toward the head, until it reaches the level of the neck. Then turn its point backward, and pass it over the neck; make quite certain that it is in right position by feeling the point behind the neck (Fig. 169, p. 488). Now draw the decapitator firmly downward, at the same time that its handle is swayed backward and forward as widely as the vaginal outlet will allow. In this way the neck is quickly cut through. As soon as the vertebræ are divided, note from time to time with the fingers the direction the plane of section is taking, and see that it does not slope too much backward into the shoulder, instead of cutting off the head. It may be necessary to incline the handle of the decapitator somewhat in the direction of the head, if this lies very high up. Take care that the last piece of tissue is not divided too suddenly, lest the decapitator injure the maternal soft parts in its sudden release.

The reason why the point of the decapitator should be turned backward is to avoid injury to the bladder. Owing to the direction of the vulval outlet, the handle must be inclined forward. There is therefore less risk of injuring the rectum by cutting downward and forward than there would be of injuring the bladder, if the point were turned toward the pubes.

By decapitation, the obstructing wedge is broken up, and the body of the fœtus is easily withdrawn by traction upon the prolapsed arm. It remains only to deal with the head. If the uterus then contracts strongly, the head may be delivered spontaneously. The uterus, however, acts at a disadvantage upon so small a body, and will probably be in a state of continuous action from protracted labour ; otherwise decapitation would not have been necessary. In this case it will be necessary to deliver the head artificially. If, as is usually the case, there are no projecting vertebræ at the stump of the neck, the best way is to hook the finger in the mouth, or the thumb in the mouth and the fingers over the base of the skull, and bring the head down in face presentation. If there is much resistance to its passage, a small blunt hook or crochet may be substituted for the finger. If however there is a sharp or rough projection of vertebræ at the neck, this would be turned sideways, and might cause injury to the cervix or vagina, if the head were brought down in face presentation. It is then better, if possible, to seize the stump of the neck with craniotomy forceps of a simple form and bring the head down like an aftercoming head. Forceps may also be employed for extraction. In the case of pelvic contraction it may be necessary to perforate the head, while counter-pressure is made by an assistant over the uterus, and afterwards extract it with the cephalotribe or by other means (see Chapter XXXV.).

Embryotomy.—Version having been found impossible, the only case in which the neck cannot be reached for decapitation is that in which there is already a tendency to spontaneous evolution, the shoulder and side descending very low into the pelvis and filling it up, while the neck remains high up (Fig. 164, p. 484). In this case the best plan is to assist evolution, either by hooking the fingers over the breech, if evolution has proceeded far enough for this to be possible, or, if not, by first hooking a small blunt hook or crochet into the thorax or abdomen, and drawing these down in succession. No space is to be gained by evacuation of the contents of the thorax, and but little in general by the evacuation of those of the abdomen. It is of little use, therefore, to perforate the thorax; but the abdomen may be perforated with advantage, if delivery is found difficult, especially if it has become at all distended after the death and decomposition of the fœtus. If the evolution could not be otherwise completed, the spinal column might be divided with strong scissors.

The same operation of dividing the spinal column, or *spondylotomy*, has been recommended by Prof. A. R. Simpson, as an alternative to decapitation. It is stated that version is thereby rendered practicable. The operation is, however, not nearly so easy as decapitation performed in the method above described, nor is the subsequent delivery so easy as that after decapitation.

PRESENTATION OF HAND OR ARM WITH HEAD.—The presentation of either hand or arm with head, or the prolapse of either by the side of the head, like the descent of the knee or foot in pelvic presentation, implies a departure from the normal attitude of the fœtus. They are, therefore, promoted by the death of the fœtus, which destroys the tonicity of muscle by which it maintains its usual attitude, and also by its immaturity. Other causes are excess 2

Causes are departure from normal attitude
(1) Death of foetus
(2) [illegible] pelvis ([illegible])

of liquor amnii; smallness of the head in reference to the pelvis, allowing room for the hand by the side of the head; and irregularity of the pelvis, especially contraction of the conjugate diameter, which prevents the head from accurately fitting into and filling up the pelvic brim. The hand may either be felt at the side of the head before rupture of the membranes, or it may be swept down in the sudden escape of a large amount of liquor amnii. Sometimes, again, the hand does not at first present with the head, but is expressed by the side of it, when there are strong pains, and the head does not fill up the brim on account of deformity. This is most likely to happen when the child is dead.

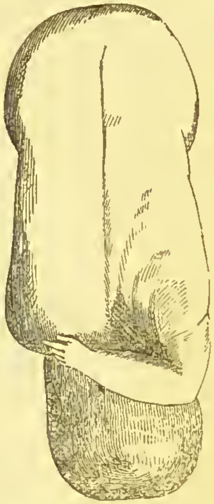

Fig. 170.—Dorsal displacement of the arm.

Obstruction is only produced when there is not room enough for the hand and head together. It is more likely to occur the more the hand is in advance of the head. If the hand only just appears by the side, it frequently remains behind as labour advances, and the head is born first. If, however, the arm is far in advance, there is danger that the head may be deflected into the iliac fossa, and the shoulder descend. If the hand is at the side of the pelvis, it is less likely to obstruct than when it lies in front, and so reduces the space in the conjugate diameter available for the head. In the Guy's Hospital Lying-in Charity, out of 22,980 births, there was a presentation of hand with head in 54 cases, or 2·2 per 1,000, or 1 in 425. 14·8 per cent. of the children, or 1 in 6·7, were stillborn.

Treatment.—Before the rupture of the membranes, an attempt may be made to push back the hand or arm through the membranes, while the other hand, used externally, fixes the head in the brim. The patient should lie on the side opposite to that on which the hand is prolapsed, in order to counteract any tendency to deviation of the head toward the iliac fossa. The attempt at reposition of the hand may be repeated on rupture of the membranes, if it has not succeeded before. If it still fails, and the hand merely descends by the side of the head, the case should be left to nature, unless symptoms of protracted labour appear. Delivery should then be accelerated by forceps, and the hand will frequently fall behind, being retarded by friction. In applying forceps care must be taken not to include the hand between the blades. If the arm descends much in advance of the head, and the head remains high in the pelvis, it is better to perform version rather than apply forceps. Version should also be performed in any case in which the head is above the brim, and contraction of the conjugate diameter is found to a degree which is likely to render the passage of the head difficult (see Chapter XXIX.).

DORSAL DISPLACEMENT OF THE ARM.—Sometimes the arm becomes displaced so that the forearm lies transversely across the back of the neck, and forms a bar or ridge which may catch upon the pelvic brim, and impede the advance of the fœtus (Fig. 170 p. 491). This condition will naturally escape diagnosis unless the hand is carried up past the head to explore, a proceeding which will generally require full administration of an anæsthetic. Such an exploration will generally have been indicated by failure to bring down the head with forceps, while there is not sufficient disproportion between the head and pelvis to account for the difficulty.

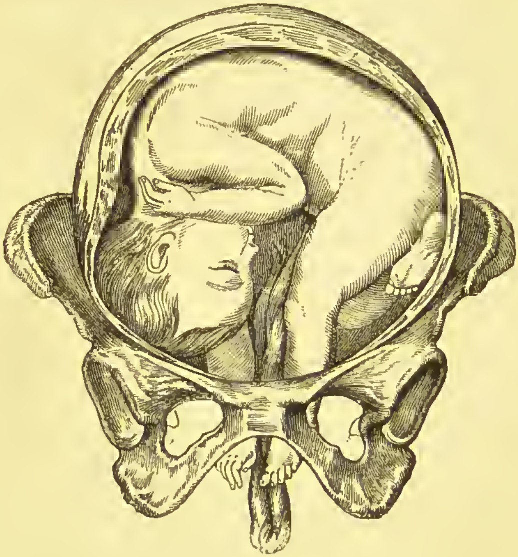

Fig. 171.—Presentation of a hand and foot with funis.

Treatment.—Extraction by forceps having, by supposition, failed, the best treatment will generally be version. Sir J. Simpson, who first described the condition, advised bringing down the arm, so as to convert the case into one of hand and arm presentation.

PRESENTATION OF HANDS AND FEET TOGETHER.—Presentation of hands with feet implies that the position of the fœtus is more or less oblique or transverse, and that legs or arms are extended

(Fig. 171, p. 492). Most frequently the breech is lying lower than the head, and the arms are extended.

Treatment.—Before rupture of the membranes, the axis of the fœtus should be brought into coincidence with that of the uterus by external manipulation, if possible, so as to produce either a head or breech presentation. If this fails, as soon as the os is fairly dilated, one foot should be brought down, and traction made upon it until the half-breech fully occupies the os, the hands have receded, and the head occupies the summit of the uterus.

Presentation of Foot with Head.—Presentation of a foot, or of both feet, with the head is very much rarer than that of hand with head. It implies a doubled-up condition of the fœtus as well as extension of the leg. Accordingly it is chiefly found with premature and dead children. If it happens with a living child, it may be due to the foot having presented in the first instance, the axis of the child being somewhat oblique, and to the head having been brought down with a rush of liquor amnii escaping suddenly. I have known this occur when the foot has been seized, in order to bring it down artificially, but not drawn down quickly enough on the rupture of the membranes. A similar condition may be produced by an attempt at version, when the foot has been brought down, but the head will not recede.

Treatment.—If the membranes are unruptured, or shortly after their rupture, the foot may be pushed up above the head if possible. Much time should not be expended upon this attempt after rupture of the membranes, especially if the child is living, since it is likely soon to perish from pressure in its doubled-up attitude. If the attempt does not succeed, traction should be made upon the foot until the half-breech is brought into the os and the head recedes. If this proves difficult, a noose of tape should be placed round the foot for traction, so as to leave the pelvis free for counter-pressure upon the head with the other hand. Traction and pressure may then be tried simultaneously, or, if this does not succeed, alternately, until the fœtus revolves. If this failed, perforation of the head would be the only remedy, but this would hardly ever be necessary. Before making traction on the foot, the physician should make sure, by abdominal palpation, that head and foot belong to the same child, not to twins: since, if they belonged to twins, the head should be delivered first, and the other treatment might lead to the twins becoming locked.

Locked Twins.—Obstruction to labour from locking of twins is rare, but is apt to be serious when it does occur, and especially fatal to the children. The children are in separate membranes in the great majority of cases (see p. 260), and then the membranes of the second child prevent its interfering with the first. Even if the twins are in a common amnion, the second child as a rule glides out of the way as the first enters the pelvis. It is only when the heads are small relatively to the pelvis that they are apt both to enter the pelvis together, and so become locked.

First variety.—The first way in which twins can become locked is when both present by the head. The second head may then be pressed in between the head and thorax of the first child, and so partially enter the pelvis with the thorax and there become arrested. The first child is in greatest danger, for the funis may be compressed as well as the thorax, if the two have advanced far into the pelvis. According to Reimann,* in six cases, five of the first children were stillborn, and four of the last.

Treatment.—The condition will generally only be discovered after birth of the first head, or an obstruction being met with to its extraction by forceps. The second head should be pushed up out of the way if possible. If this cannot be done, delivery must be effected by traction on the first child. Perforation of the second head will rarely be necessary.

Second variety.—The second variety of locked twins arises when the first child presents by the pelvis and the second by the head. The head of the second child may then enter, or partially enter, the pelvis, pressed in between the head and thorax of the first. The first child then quickly perishes, its funis being exposed to pressure. If space is ample both children may pass the pelvis together in this position. In some cases the whole of the second child has been spontaneously expelled before the delivery of the first head. According to Reimann, 23 out of 26 of the first children, but only 10 out of 29 of the second children, in such cases were stillborn.

Treatment.—If the heads are still high in the pelvis, it may be possible to push up the lower head out of the way while the first child is delivered; otherwise the lower head should be extracted with forceps. If this cannot be done, since there is little chance of saving the first child, the head of this child, lying uppermost, should be decapitated with the serrated hook (see p. 488) or scissors. The body of the first child is then easily delivered, next the second child, and finally the head of the first. If the head cannot be decapitated, it may be perforated, but this does not so completely overcome the difficulty. These expedients failing, there remains the resource of perforating the lower head, and extracting with the cephalotribe, or by other means, but this plan involves the death of both children.

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* "Amer. Journ. of Obstet.," Vol. I.

Fœtal Monstrosities.

Conjoined twins.—Conjoined twins are extremely rare, compared with the total number of deliveries, but a considerable number of cases altogether have been recorded. Conjoined twins are divided by Playfair * into the four following classes, including all varieties likely to cause much difficulty in delivery :

A.—Thoracopagus. Two nearly separate bodies united in front, to a varying extent, by the thorax or abdomen.

B.—Ischiopagus. Two nearly separate bodies united back to back by the sacrum and lower part of the spinal column.

C.—Dicephalous monsters, the bodies being single below, but the heads separate.

D.—Cephalopagus. The bodies separate below, but the heads fused or partially united.

Out of 31 cases collected by Playfair, spontaneous delivery took place in 20.

Class A.—This is the most numerous, including 19 cases out of 31. Both children present by the feet in a much larger proportion of cases than normal children. Playfair regards this as the most favourable presentation, and recommends version in the rare cases of head presentation, in which a diagnosis can be made early enough to allow it. The bodies generally pass the pelvis parallel to each other, without much difficulty, but obstruction may arise when the heads enter the brim. Owing to the bodies being inclined forward toward the pelvic outlet, the posterior head will enter the brim in advance. In aiding delivery it is important to bring down this head as far in advance of the other as possible. The bodies should therefore be carried as far forward as possible, and traction made chiefly upon the body belonging to the posterior head. Forceps may be applied to this head, if necessary, or it might be requisite to perforate it.

When the heads present spontaneous delivery may occur in one of two ways. In the first and more common the head of the first child is born first, and advances until it is arrested by tension upon the band or surface of union. Then the two bodies are born together by a kind of spontaneous evolution, the body of the first child in advance. In this evolution, the second head remaining above the brim, a rotation of the two bodies, accompanied by a doubling-up, takes place around the point where the neck of the second child rests upon the pelvic brim. It is somewhat analogou to the spontaneous evolution in shoulder presentations (see p. 483). Finally, the second head is delivered.

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* "Obstet. Trans.," Vol. VIII.

In the second mode of delivery, both heads are in the pelvis together, the second head being pressed in between the head and thorax of the first child, as in the first variety of locked twins. The lower head will become anterior towards the pelvic outlet. For this mode of delivery it is essential that the children should be very small in proportion to the pelvis.

Treatment.—In the case of head presentation a diagnosis is only likely to be made when the progress of the first child is arrested after birth of the head or in the pelvis, and for this purpose complete anæsthesia and the introduction of the hand will generally be necessary. Evolution may be assisted by traction upon the conjoined bodies, or bringing down the feet if practicable. In case of necessity there need be little hesitation to divide the band of union, or carry out any other form of embryotomy which appears to be indicated. If the first head is still in the pelvis, version should be performed, and all four feet brought down.

Class B. comprises 3 cases out of the 31. The children in these were delivered spontaneously, the first head in advance, then the bodies by evolution, then the second head. Delivery in this way is easier than in Class A., because the junction is generally lower down, allowing the bodies to be more separated, and more of the body of the first child to be born, before traction comes upon the surface of the union, and evolution commences.

Class C. comprises 7 cases out of the 31 (Fig. 172). In two the children were delivered spontaneously. The usual mechanism is the delivery of first the first head, then the body by evolution, then the second head.

Treatment.—Evolution should be assisted by traction upon the body, or by bringing down the feet, if possible, after the birth of the first head. If this cannot be effected, some extra space may be gained by evisceration. If the first head is arrested within the vagina, its removal by decapitation, or perforation, may be necessary before the feet can be brought down.

Class D. is the rarest, comprising only 2 cases out of the 31. The enlarged monstrous head is the part most likely to cause difficulty. It must be delivered, if necessary, by craniotomy.

In all these classes the prognosis to the children is very bad, since they are often premature, and subjected to pressure in a doubled position. The results to the mothers have been favourable.

Other forms of monstrosity.—There is another variety of double monster, which does not usually cause much difficulty in delivery, namely, that in which there is partial or complete doubling of upper or lower limbs, generally of the latter.

Acardiac monsters.—The production of an acardiac monster out of one of twins, when the umbilical arteries communicate, by reversal of the current of blood in the weaker child, has already been described (see p. 260). There may be a large shapeless mass, replacing the head and thorax, formed by hypertrophy of a low form of cellular tissue and œdema, but it rarely causes difficulty in delivery. The monster generally presents by the feet. The amorphous variety of acardiac monster, in which there is merely a shapeless mass, without either head or limbs, has to be extracted like a detached head after the birth of the first twin.

Anencephalic Monsters.—In these there is absence of the brain and vault of the skull, the eyes are prominent, and the face looks upward. The neck is short, the shoulders relatively broad and large. This form of monstrosity has been supposed to originate from hydrocephalus at a very early stage of development, followed by rupture and disappearance of the brain substance. Other authorities deny this explanation. If the head presents, it generally does so by the face. Pelvic and transverse presentations are common. If the head presents it may cause difficulty in diagnosis. The nature of the case will be discovered by recognising the features of the face, not surmounted by any cranium, and feeling the sella turcica and other projections of the base of the skull. The broad shoulders may cause delay in delivery, especially when these follow the head, too small to dilate a passage for them. If labour is protracted from this cause, while the head is yet high in the pelvis, version should be performed, and delivery accelerated by traction.

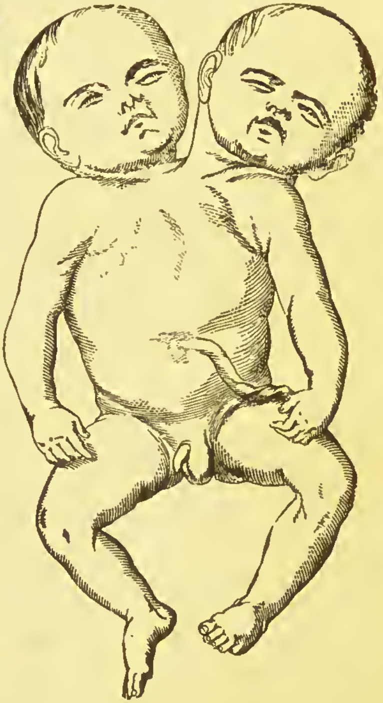

Fig. 172.—Double-headed monster.

Extroversion of Viscera.—In some cases a large portion of the viscera, especially the liver and the small intestines, lie outside the abdomen, uncovered by skin. This condition is sometimes associated with shortness of the funis, which is attached to the extroverted mass. The deformity more often causes difficulty in diagnosis of the presentation than difficulty in labour. The fœtus is often in a position of extension or opisthotonos, and the liver, or other part of the extroverted mass, may then present. It may at first be mistaken for a placenta prævia, but is distinguished from it by the absence of hæmorrhage. If the extroverted mass presents, version should be performed, as in other cases of transverse presentation.

EXCESSIVE DEVELOPMENT OF THE FŒTUS.—Excessive size of the fœtus is rarely so extreme as to cause much difficulty in a perfectly normal or wide pelvis. Combined, however, with slight degrees of narrowness in the maternal passages, a large size of the fœtus is one of the commonest causes of difficulty. Thus the greater size of male children, and firmer ossification of their cranial bones, are the reasons why a greater proportion of males is stillborn. Excessive size of the fœtus may depend in part upon the size of the parents, and is likely to be most marked in relation to the pelvis, when the father is very large in proportion to the mother. The size of the children also increases, up to a certain point, with the age of the mother and the frequency of pregnancies (see p. 83).

Excessive ossification of the cranial bones is recognised by unusual smallness of the anterior fontanelle, and the unyielding feel of the bones, even near their edges. Combined with a moderate disproportion of the head to the pelvis, it very greatly increases the difficulty of delivery, since the diminution of the cranial diameters by moulding is rendered difficult.

Treatment.—Protracted labour from excessive size of the fœtus is to be treated in the same way as when due to equable contraction of the pelvis. The size of the head cannot be exactly measured, but can only be estimated generally from the comparatively slight curvature of the cranial bones, the length of the sagittal suture, and the degree to which the head fills up the pelvic space, or its failure to enter the brim. Bimanual examination may assist the diagnosis when part of the head can be felt above the brim. In general extraction by forceps will be sufficient to meet the case. In rare cases, after delivery of the head, detention of the thorax takes place at the outlet from its excessive size, and may even lead to the sacrifice of the child's life. If moderate and cautious traction on the neck, in conjunction with a pain, does not effect delivery, the finger should be passed into the vagina, and hooked into the posterior axilla. Traction is then made upon the axilla in conjunction with that upon the neck. If necessary the rotation of the shoulders into the antero-posterior diameter of the pelvis should be aided. If the finger does not suffice the small blunt hook used in version (see Chapter XXXIV.) may be passed round the axilla, and traction made with that. Care must be taken that its point is clear of the axilla on the other side. In an extreme case, the posterior arm, and then, if necessary, the anterior arm, may be drawn down over the chest, so as practically to reduce the dimensions of the thorax.

The shoulders may also be arrested higher in the pelvis, but this very rarely happens except in cases where there is pelvic contraction, and the head has been brought through the brim after craniotomy. In such a case, space having been gained by the lessening of the head, the small blunt hook may be fixed in the posterior axilla. If this does not succeed the arms may be brought down by the aid of the same instrument. Afterwards extraction may be aided by fixing the small hook or crochet in other parts of the thorax or abdomen. If, with an after-coming head, extraction of the body gives great trouble, the small blunt hook may be used to bring down the arms. The child being dead, space may be gained, if necessary, by evisceration.

ŒDEMA OF THE FŒTUS.—Œdema of the fœtus may result from congenital malformations of its heart or large vessels, or it may be associated with œdema of the placenta, and depend upon disease of that organ; or, again, it may be associated with œdema of the mother from Bright's disease. According to Spiegelberg,* congenital syphilis is a frequent cause. In a few cases there is not merely infiltration with serum, but a hyperplastic condition of the cellular tissue and skin. Otherwise the skin and tissue beneath are generally more friable than usual.

Treatment.—The child is generally incapable of surviving long. In case of difficulty, therefore, there need be little hesitation about performing craniotomy; delivery may then be assisted by fixing the small blunt hook or crochet into any convenient parts of the body. The swelling may also be diminished by making incisions or punctures through the skin.

EMPHYSEMA OF THE FŒTUS.—Emphysema is the result of decomposition of the fœtus following its death either before or during labour, and the access of air to it. The effusion of gas may take place both into the serous cavities and into the cellular tissue. In the latter case there is crackling under pressure by the finger. At the same time the tissues become friable. The abdomen is the part most likely to cause difficulty in delivery by its distension, but even the breech and limbs may become considerably swollen.

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* "Lehrbuch der Geburtshülfe," p. 481.

Treatment.—If labour is obstructed, the accumulated gas should be let out, especially from the abdomen, by puncture with the perforator or any other convenient instrument. If necessary, the skin of the breech or other parts may be incised with scissors. In extraction, it is to be remembered that the limbs are liable to tear away.

CONGENITAL HYDROCEPHALUS.—In congenital hydrocephalus there is a watery effusion within the ventricles of the brain (Fig. 173, p. 501). In rare cases the effusion may be between the brain and the skull. The dimensions of the child's head are often enormously increased, the brain being spread out as a thin layer over the serous fluid. The average diameter of the head is thus not very rarely increased to as much as 7 or 8 inches. In general the cranial bones are thin, soft and spread out, but not so much so as completely to cover the whole surface. Thus not only the fontanelles but the sutures are very wide, and the bones easily moveable upon each other. In rare cases, especially when the effusion is moderate, the bones are more firmly ossified and more completely cover the enlarged head. The face is small relatively to the head, the forehead projecting over it at an angle, the frontal suture gaping. The body may be of normal development, or wasted. Hydrocephalus is sometimes associated with spina bifida, or hydrops amnii. The frequency of hydrocephalus is estimated by Lachapelle as 1 in about 2,900 deliveries. In the Guy's Hospital Charity, however, perforation or puncture on account of hydrocephalus was called for only once in 23,591 deliveries. In general, interference is called for in about three-fourths of the cases. Pelvic presentations are much commoner than in normal cases (about 1 in 5), especially when the distension of the head is very great, for then the adaptation of the child to the uterus takes place best when the head is uppermost. (See Fig. 61, p. 99.)

Course and terminations.—When the amount of fluid is moderate, the head not tense, and the bones soft, the head may be compressed and squeezed through the pelvis by the natural powers. More frequently labour becomes arrested, the head not entering the brim, and symptoms of protracted labour arise. The difficulty in delivery depends not only upon the size of the head, but upon the tension of the fluid in it, and the degree of ossification of the bones. Sometimes it is overcome by spontaneous rupture and escape of the fluid, especially when the child is dead and decomposition commencing. Spontaneous delivery occurs more easily with an after-coming head, because the head then enters the pelvis with the narrower end of the wedge foremost. Compression of the bones may then also be assisted by traction. Rupture of the uterus is relatively frequent. It occurred in 16 cases out of 70 collected by Dr. Thomas Keith. This is probably to be explained not only by the obstruction to labour, but by the large size of the head, which, in head presentations, is forced down into the lower distensible segment of the uterus, as the upper contractile portion retracts. This produces great transverse stretching, and thereby a tendency to longitudinal rupture.

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Prognosis.—The mortality to the mothers has been reckoned to be as much as 1 in 4. There is, however, little danger if the case is early recognised and treated. The risk lies in its nature being overlooked. The child generally perishes, and, in any case, it is not capable of prolonged life.

Diagnosis. — In head presentations, the head will be high up, not entering the brim, and the presenting part may be made out as less convex than usual, forming part of a larger spheroid. The wide fontanelles and sutures, soft bones, and compressible character of the head generally render the diagnosis easy. The head is distinguished from the bag of membranes or cystic tumours of the fœtus by the presence of hair, and of the cranial bones. If the bones are much ossified, diagnosis is more difficult, and the whole hand should be introduced into the vagina for exploration if necessary. The brow may then perhaps be reached, and the overhanging forehead and open frontal suture made out. Another most valuable means of diagnosis is the estimation of the size of the head bimanually, since from its magnitude and high position it can usually be defined quite easily from the abdomen. In general there will be urgent pains, combined with failure of the head to descend, and the absence of any pelvic contraction to account for this. The urgency of pains is not, however, always noted, if the head fails to enter

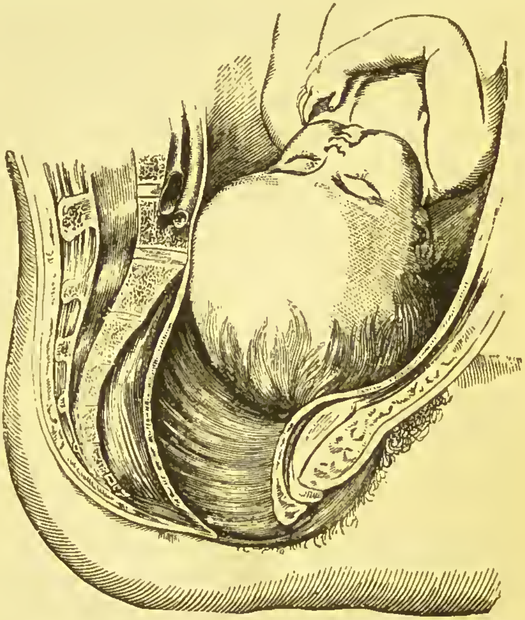

Fig. 173.—Labour impeded by hydrocephalus.

the brim at all. If forceps are applied, they often slip off, in consequence of the collapsible character of the head. If the bones are firmly ossified, the handles may remain widely separated when the forceps are locked. When the pelvis presents, the presence of hydrocephalus is generally only discovered when the head cannot be brought into the brim. The unusual size of the uterine tumour and bimanual estimation of the size of head will then generally reveal the true state of the case.

Treatment.—Forceps will generally slip off the head, and it is not usually worth while to attempt delivery by version, since the child is probably never capable of prolonged life. For the same reason there is no object in puncturing with a small trocar, in order to secure a living child, unless it should be of legal importance to secure the birth of a child, even though it lives for only a short time. The distended head may be punctured with the perforator, by preference in an interval between bones, near the most prominent part. If it does not quickly descend, it is then extracted by craniotomy forceps or cephalotribe. If an after-coming head cannot be drawn through the brim, it should be perforated in the manner described in the chapter on craniotomy. A possible alternative is to let off the fluid by a catheter passed into the spinal canal.

Ascites, Hydrothorax, Distension of Abdomen.—Ascites and hydrothorax may arise from chronic intra-uterine inflammation of the fœtus, due to syphilis or other causes, or to malformation or obstruction of veins. Hydrothorax is very rare, except in association with ascites. The abdominal distension is most likely to be the cause of difficulty in labour, but, on account of the yielding nature of the abdominal walls, this is only the case when distension is considerable. Another cause of abdominal distension is occlusion of the urethra or ureters from malformation or inflammation. The fœtal urine secreted then accumulates, and produces distension of the bladder, ureters, or kidneys, according to circumstances. I have found it necessary, in order to effect delivery, in a case of pelvic presentation, to perforate first the bladder, and then two cystic tumours formed by the ureters. Here there was occlusion both of the urethra and of the lower part of the ureters, the latter probably being of later date. The abdomen may also be distended by other causes, which less frequently lead to enlargement great enough to call for interference. Among such causes recorded are enlargements or tumours of the liver, kidneys, spleen, or pancreas, and an included fœtus situated in the abdomen. In the latter case one ovum appears to be included within another, and to undergo partial development, deriving its nourishment by its attachment to the other.

Diagnosis.—The morbid condition is generally first discovered when the fœtus will not advance after the head has passed through the pelvis. The hand being then passed up to ascertain the cause, enlargement of the abdomen or thorax is detected. A complete diagnosis is generally impossible till after delivery.

Treatment.—In minor degrees of enlargement, delivery may be effected by traction upon the head with forceps, or after its delivery, or by traction on the legs in pelvic presentations. If this does not succeed, the abdomen, or if necessary the thorax, should be pierced with a trocar and cannula. In the absence of a trocar, the perforator may be used to pierce the abdomen, unless there is legal importance in securing a child to live if only for a short time. If the perforator is used in a cranial presentation it is better to perforate also the head, and destroy the medulla (see Chapter XXXV.), lest a living child be born with a lacerated abdomen. If the cause of obstruction proves to be solid, it may be necessary to perform complete evisceration, and perhaps to apply the cephalotribe over the abdomen for extraction.

CONGENITAL ENCEPHALOCELE.—In congenital encephalocele a serous sac is attached to the head by a base or pedicle of varying breadth. It is filled with cerebro-spinal fluid, originally continuous with that in the head. Generally the communication still exists at birth, but the pedicle may be found impervious when of small size. Cerebral substance may or may not be spread out more or less over the surface of the sac. Encephaloceles are most frequently situated in the middle line. The commonest seat is the occiput (Fig. 174, p. 504), next to that the frontal region. They may be of any size up to one considerably larger than the head itself. Difficulty in parturition is generally produced only when the sac is of large size, since from its position it generally passes through the pelvis in front of or behind the head, and is compressible. In the case figured, one recorded by Dr. Meigs, the head was born first, and then, the sac remaining above the pubes, the rest of the body was born by spontaneous evolution. The sac was then delivered intact by powerful traction. The sac may be mistaken for a second bag of membranes. In case of delay the diagnosis must be made by passing the hand high up into the pelvis.

Treatment.—If traction is not sufficient to effect delivery, the sac should be punctured by trocar.

SPINA BIFIDA.—In spina bifida a similar serous sac, its contents generally continuous with the cerebro-spinal fluid, is situated over the lumbo-sacral region. Its size may be as large as that of a fœtal head. In this case also the sac has to be distinguished from a bag of membranes, especially if it presents alone at the os.

Treatment.—If delivery cannot be effected by traction, the sac must be punctured.

OTHER EXTERNAL TUMOURS.—Tumours growing externally, of cystic, fatty, cancerous, or other structure, are a rare cause of difficulty in parturition. They may be situated on the neck, chest, axillæ, and other parts, but especially about the sacral region. The most common tumour in this situation is a cysto-hygroma, which may attain considerable size.

Treatment.—Puncture should first be tried, if delivery cannot be effected with the tumour intact. If this does not succeed, it may be necessary to incise or crush it.

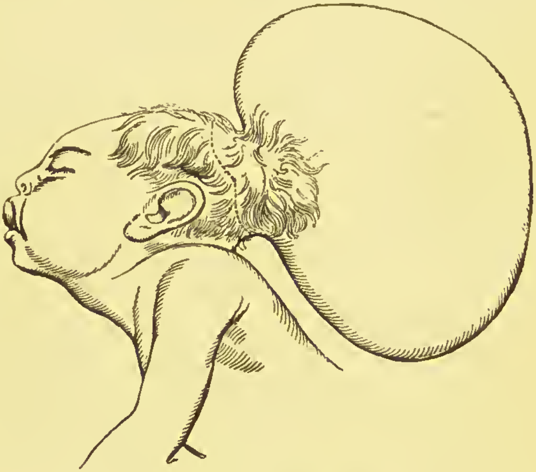

Fig. 174.—Encephalocele.

ANOMALIES OF THE MEMBRANES.—Undue friability of the membranes leads to their premature rupture, and consequent prolongation of the first stage of labour. The effects of undue toughness are generally obviated by artificial rupture. If not, the membranes may remain intact in the second stage, as they have done in the case shown in the frozen section (fig. 72, p. 155). The second stage is then prolonged, both from the less vigorous action of the uterus, and from the larger size of the body to be expelled. Sometimes the child, when small, is even expelled with the membranes intact. It then quickly perishes from asphyxia, unless the sac is artificially ruptured. A child born with the membranes over its head is popularly said to be born with a "caul."*

When the child is born with a caul, or even when the bag of membranes descends far in advance of the presenting part, special care should be taken to see that none of the chorion is left behind in the uterus. For the amnion will then often have come down alone separated from the chorion (see p. 157); and the aid to the separation of the chorion, afforded by its attachment to the amnion, thereby fails.

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* From *alea* a helmet.

Undue Shortness of the Funis.—Obstruction to labour may arise from either actual or relative shortness of the funis, but much more commonly from the latter. Relative shortness arises from the funis being wound round some part of the fœtus, generally round the neck. Thus an actually long funis, when wound two or three times round the neck, may become a relatively short one. Moreover, since the neck is as much as three inches further from the placental insertion than the umbilicus, the available length has to be so much the greater when the funis is round the neck, if no obstruction is to arise. According to Matthews Duncan's experiments,* the average length of a normal funis was found to be 17½ inches, and the average stretching under tension before breakage amounted to one sixth of the original length. The average breaking strain was 8¼ lbs., the weakest funis requiring 5½ lbs., the strongest 15 lbs., to break it. The breaking strain gives the limit to the force obstructing labour which a funis can exert.

Extreme actual shortness, such as a length of four inches or less, is excessively rare. Monsters have occurred, however, in which there is no funis, the extroverted viscera being in direct contact with the placenta. In such a case even the earlier part of the expulsive stage of labour might be affected. In general the placental as well as the fœtal attachment descends to some extent in the earlier part of labour, and the funis is therefore less likely to be put early upon the stretch. It is very rare for the funis to cause obstruction before the birth of the head, or that of the breech in pelvic presentations. More commonly obstruction arises after birth of the head, and still more commonly after that of the shoulders, the cause being generally the winding of the funis round the neck.

Results and terminations.—The result may be rupture of the funis, separation of the placenta before delivery, or inversion or partial inversion of the uterus. Inversion has been recorded as due to this cause, but is very rare, since the funis is only put on the stretch when the uterus is acting, and therefore not prone to become inverted. Probably it could only occur through artificial traction. The most common result, if the funis is wound round the neck, and no artificial relief is given, is that birth takes place by a kind of spontaneous evolution. The neck is fixed under the pubic arch by the tight funis. The tension causes a partial undoing of the twist round the neck, and so rotates the fœtus with its abdomen forward. Then evolution takes place by a rotation of the body round the point where the neck is fixed by the funis as a centre, accompanied by a doubling up, the body coming down posteriorly. It is somewhat analogous to spontaneous evolution in shoulder presentation, where the rotation is round the point where the neck is fixed against the pelvic brim. The fœtus may be asphyxiated meantime by the pressure of the funis round its neck, together with the retention of the chest within the vagina.

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* "On Shortness of the Cord as a cause of Obstruction to the Natural Progress of Labour," Obstet. Trans., Vol. XXIII.

Diagnosis.—In the rare case of obstruction caused by the funis before delivery of the head, diagnosis is difficult. Shortness of the funis may be suspected if the head is arrested, though not tightly grasped in the genital passages, and recedes in a marked way in the interval of pains, still more if, in addition, ante-partum hæmorrhage occurs when the head is in the vagina, not accounted for by vaginal or cervical laceration. A coil of the funis round the neck may possibly be detected on rectal examination. In general, the head would have to be delivered by forceps without exact diagnosis of the cause of delay. In pelvic presentation, tension of the funis would be more easily detected, the hand being passed up to ascertain the cause of difficulty. One of the symptoms given is special pain at the placental site during a uterine contraction, or when traction is made on the fœtus. There may possibly be a recognizable depression at the placental site, if traction is made on the fœtus when the uterus is lax. Dr. Braxton Hicks* has recorded a case in which a funis only four inches long had to be divided within the uterus.

Treatment.—As soon as the head appears, if a coil of the funis round the neck is discovered, the funis should be drawn down as much as possible so as to slacken the loop, and the loop or loops passed over the head, or, if this is impossible, over the shoulders. If it is too late thus to release the coil, or if the pains are too rapid and violent to allow it, and the funis is drawn tight, or impedes the advance of the child, the funis should be divided with scissors. The fœtal end may be compressed between the finger and thumb until after the delivery of the child, accelerated, if necessary, by traction, and then it should be tied in the usual way. Impediment due to absolute shortness of the funis should be treated in the same way by division.

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* Obstet. Trans., Vol. XXIII.

CHAPTER XXIX.

ANOMALIES OF THE PELVIS.

Enlarged Pelves.

A pelvis larger than the normal may occur simply as a part of the general large size of the body. In general, however, it is not specially tall women who have large pelves, but rather those who are broad, and have the feminine characteristics well marked, sometimes even though they may be below the average height. Tall muscular women often have a pelvis rather small in proportion to their size. A large pelvis is generally normal in its proportions, and is then called the *Pelvis Æquabiliter Justo Major*. In some cases there may be an exaggerated development of the special characteristics of the female pelvis, particularly of the relatively wide transverse diameter. In cases of double uterus, a marked increase in the transverse diameter has been noted.

An enlarged pelvis cannot be regarded as a pathological condition. The only disadvantages likely to arise from it are the inconveniences which may result from precipitate labour. On the whole it may be considered an advantage to have a pelvis above the average size. It has been stated that labour is not necessarily easy in large pelves, because from want of close adaptation the head may fail to undergo the usual rotations. These rotations, however, depend to a considerable extent on the soft parts, and it appears that the head does undergo them, so far as is necessary for its easy delivery.

Contracted Pelves.

General forces concerned in the production of pelvic deformities.—The forces upon which the shape of the pelvis chiefly depends are the vital forces of growth and development, the effect of the body weight and the resistances which it calls out, and the pressure and traction of muscles and ligaments. The results of these may be seen in all forms of deformed pelves as well as in the development of the normal pelvis. When the bones are softened, the effects of the mechanical forces are exaggerated. In many forms of distortion the shape of the pelvis depends upon the alteration of the points of application of the mechanical forces owing to some local want of development or disease, or to deformities or injuries of the spine or limbs.

The mechanical forces which influence the shape of the normal pelvis in growth from infancy to adult life, and the exaggerated or uncounteracted or one-sided influence of which is concerned in the production of many pelvic deformities, have already been described (see pp. 21—28). The reader is recommended to refer back to that description before reading the account of the mode of production of the varieties of deformed pelvis. Certain influences which are in action in the formation of all varieties of pelvis will here be briefly recapitulated.

(1.) **Effect of the pelvic inclination.**—If pelvic inclination is increased beyond the normal angle, the sacrum tends to sink more towards the centre of the pelvic brim, and the effect, both of the body-weight and of the traction of the abdominal muscles, to widen the pelvis transversely and flatten it antero-posteriorly, is increased. If pelvic inclination is diminished the contrary effects are produced, and the tendency is to increase the antero-posterior and diminish the transverse diameter of the pelvis. At the same time the sacrum tends to sink down more deeply between the ilia in the direction of the coccyx.

(2.) **Effect of standing, walking, &c.**—The effect of standing, walking, or running is to call into play the inward pressure of the head of the femora upon the acetabula due to muscular action (see p. 23), as well as the reaction to the body-weight. Hence the tendency of the body-weight to widen the pelvis through the leverage exerted upon the innominate bones (see p. 22) is resisted by the inward pressure at the acetabula more in children who stand, walk, and run much, than those who are constantly sitting. This principle is especially illustrated by the form of almost uniformly contracted, not flattened, pelvis, occasionally met with as the result of rachitis, as contrasted with the usual flattened rachitic pelvis. Such a form of pelvis is attributed to the occurrence of rachitis at rather a later age than usual, so that the child is not constantly sitting, but standing and moving about.

If one or both acetabula are for any cause displaced inwards towards the middle line, the effect of the reaction to the body-weight is altered. It has been already explained that this reaction is directed vertically upwards (see p. 23). Its effect upon the shape of the pelvic brim depends upon that of its component resolved in a plane parallel to the brim (see Fig. 18, p. 23). If the acetabulum is nearer the middle line than the sacro-iliac joint the line of this force will fall inside the fulcrum of the lever instead of outside, and the force will therefore tend to thrust the lower end of the lever inward instead of outward. Hence, if an acetabulum is displaced inwards nearer to the middle line than the sacro-iliac joint, the reaction to the body-weight assists the inward thrust of the muscular force acting on the femur instead of tending to counteract it. If the acetabulum is displaced inwards in any degree at all, the counteracting force to the inward thrust is diminished. An instance of this effect occurs, as will shortly be described, on both sides in the triradiate pelvis, whether of the malacosteon or pseudo-malacosteon form, on one side in the various forms of oblique pelvis.

Effect of sitting.—It has already been explained (see p. 25), that, in sitting, the body-weight tends to widen the whole pelvis by the leverage it exerts on the innominate bones, and also that the reactions to the body-weight through the tubera ischii tend to rotate the lower part of each innominate bone outward on an axis joining the centres of the symphysis pubis and sacro-iliac synchondrosis, and so specially to widen the pelvic outlet, increasing the distance between the tubera ischii, and widening the pubic arch. In the case of congenital absence of the legs, where the person can sit, but not stand, the pelvis, both at brim and outlet, has been found wider than normal, the inward thrust at the acetabula being wanting.

As in the case of the acetabula, the action of the force is diminished, and eventually reversed, if the tuber ischii is displaced inward. If the tuber ischii lies nearer the middle line than the sacro-iliac joint, the tendency will be to thrust the anterior end of the innominate bone inward instead of outward; if it lies inside the line joining the centres of the symphysis pubis and sacro-iliac synchondrosis, the tendency will be to rotate the lower part of the innominate bone inward instead of outward. If the usual widening effect is merely diminished owing to partial displacement inward of the tuber ischii, the inward tension of the sacro-sciatic ligaments may be sufficient to overcome it. On the contrary, if the pelvis is wider than normal, the tendency of sitting to widen the outlet is yet further increased. Hence the general rule is that a pelvis relatively wide at the brim is still wider at the outlet, and a pelvis transversely contracted at the brim is still more contracted at the outlet. The principle is also illustrated both in the triradiate pelvis, and in oblique pelves.

Diagnosis of pelvic contraction.—The general diagnosis of pelvic contraction will be considered before the special varieties of pelvis are described. General indications, such as may be obtained from a person's appearance, indicate usually simply the probability that some pelvic deformity may exist rather than its nature or degree. They are chiefly of use in showing, in the case of a woman pregnant for the first time, when it is desirable to make a local examination as to the capacity of the pelvis before the full term arrives, and so possibly avoid a very difficult and dangerous delivery by the induction of premature labour. Such indications consist in smallness of the whole figure, especially if accompanied by slenderness, relative shortness of limbs, pointing to the probability of rachitis, spinal curvatures, lameness, especially if due to shortness of one leg, undue hollowness of the back, pointing to the probability of excessive pelvic inclination, and any other deformity affecting the back or legs. Attention should be paid to any history of rickets, or other disease of bones, or of any disease or injury affecting the back, pelvis, or legs. Rickets may also be revealed by curvature and thickening of the tibiæ. If previous deliveries have occurred, the history of the course of parturition is the most important guide of all.

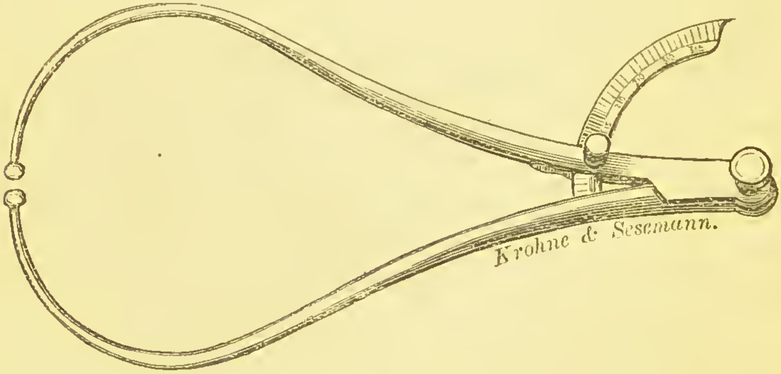

Fig. 175.—Pelvimeter.

Pelvimetry.—For the exact diagnosis of pelvic deformity, it is necessary to take certain external and internal measurements. The external measurements are obtained with ease, but do not allow any exact inferences to be made as to the size of the pelvic canal, which is the only point of real importance. They are of value, because they not only give evidence, in many cases, of the existence of deformity in the canal, although not of its precise degree, but often indicate the general character of the pelvic distortion, as, for instance, that it is due to rickets, or that oblique distortion exists.

The form of pelvimeter used for external measurements is shown in Fig. 175, p. 510. It is simply a modification of the ordinary callipers used by carpenters, having an index near the hinge, from which the distance separating the points can be read off. One arm may be made straight, if it is desired to have an instrument which may be used for measuring the thickness of the bones, with one arm in the vagina and one outside. The internal measurements are of most direct importance, but are more difficult to obtain with exactness. Various pelvimeters have been invented for taking them, but on the whole the fingers are to be preferred to any. They can be used with less pain to the patient, and being sentient, are less likely to lead to the fallacy which may arise, if the points of the pelvimeter are not in reality exactly where they are supposed to be.

External measurements. — The most important of the external measurements are two, the distance between the anterior superior spines of the ilium (Dist. Sp. Il.), and the maximum distance between the outsides of the iliac crest (Dist. Cr. Il.). These measure normally about 10 and $10\frac{3}{4}$ inches respectively. For the measurement the patient is placed on her back, and may be covered with a thin garment. For the first measurement the tips of the callipers are placed outside the spines. For the second the callipers are set at the smallest width which will allow them to pass over the widest part of the crests, or over their centres about $2\frac{1}{2}$ inches posterior to the spines, if the spines are wider apart than any other portion of the crests.

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Contraction of the pelvis may be indicated by one of two things. (1.) The distances may both be less than normal. (2.) The relation between them may be altered in such way that either the distance between the spines is greater than the distance between the crests at any other point, or at any rate is not exceeded in the usual proportion by the maximum distance between the crests. If the spines are wider apart than any other part of the crests, the pelvis is flattened and rachitic, with a greatly contracted conjugate diameter. If even the excess of the maximum distance over that between the spines is less than in due proportion, the pelvis is probably flattened and rachitic. One exception to this rule, however, occurs in some cases of the rachitic generally contracted pelvis, in which the relation between the two distances is altered in this way, but the pelvis is not flattened. If not only the relation of the two distances is altered, but the mean of the two is too small, there is a generally contracted pelvis, which is also probably flattened. If, on the other hand, the due relation between the two distances is preserved, but both are smaller than the normal, there is probably a generally contracted pelvis, without flattening. There may also be one of the rarer forms of pelvis, contracted in the transverse diameter; but in this case the external conjugate diameter will be above rather than below the average; while, in the generally contracted pelvis, it is below the average.

The external measurement next in importance, but of inferior value to these transverse diameters, is the external conjugate diameter (C. Ext.). In measuring this, the patient is placed upon her side; one point of the callipers is placed in front of the top of the symphysis pubis, the other just below the spine of the last lumbar vertebra. The external conjugate is on the average about 7½ inches. The object of measuring this distance is to calculate from it the probable size of the internal true conjugate diameter. It does not, however, lie exactly in the pelvic brim, for the plane of the brim cuts the spine above the last lumbar vertebra, as may be seen from the frozen section, Fig. 72, p. 155. Moreover, the amount to be deducted from the thickness of the bones and soft parts varies very widely in different cases, the difference being as much as an inch, or even more. Especially in the rachitic pelvis, the thickness of the sacrum, where the projecting promontory is formed, is apt to be greater than usual. The thickness of the external soft parts is also variable. Hence moderate values of the external conjugate, such as those between 7 and 7½ inches, give little information about the state of the pelvis. It is only from more extreme values that any positive conclusions can be drawn, and even then only as to the fact of contraction or its absence, and not as to the degree. Thus if the external conjugate measures over 7½ inches, it is pretty certain that there is no flattening; if it is under 7 inches, a contracted conjugate may be inferred.

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It is indeed possible to measure separately the portions to be deducted from the external conjugate at its anterior and posterior part by placing one arm of the callipers inside the vagina, and the other outside the body, and then get the true internal conjugate by deducting these from the external conjugate. This can be done tolerably well in some cases to obtain the thickness of the sacrum and soft parts covering it. But it is scarcely possible to get the internal arm of the callipers sufficiently high on the internal surface of the symphysis pubis to measure the thickness of the anterior pelvic wall with accuracy. This method, therefore, probably does not give the true conjugate with so great accuracy as that of deducting it from the diagonal conjugate, measured internally. If the method is used, the callipers should have one arm curved, as in Fig. 175, p. 510, the other straight or nearly straight. The curved arm should be introduced into the vagina, to place against the promontory of the sacrum, the straight arm to measure the thickness of the pubes.

When a transverse contraction or asymmetry of the pelvis from want of development of both or of one wing of the sacrum is suspected, the transverse distance between the posterior superior spines of the ilia is a measurement of some value, since it gives some indication whether or not the sacrum is narrower than usual. Its average magnitude is about 5 inches.

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Certain oblique external diameters should also be measured when an oblique pelvis is suspected. These will be mentioned in the account of the diagnosis of the oblique pelvis. In the comparatively rare case of contraction of the pelvic outlet, the antero-posterior diameter of the outlet is obtained by measurement with the index finger, introduced into the vagina, the radial border pressed against the apex of the pubic arch. It is measured from the apex of the pubic arch, at its internal surface, to the tip of the sacrum, not to the tip of the coccyx, unless that bone is anchylosed to the sacrum. The transverse diameter is measured between the internal margins of the tubera ischii. It may be measured either by callipers or by a straight rule, the patient being placed on her side. The average normal magnitude of the former diameter is about $4\frac{1}{2}$ inches, of the latter about $4\frac{1}{4}$ inches.

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External examination also reveals, apart from the measurements, certain general facts about the pelvis, such as the massiveness of the bones, development of prominences for attachment of muscles, direction of iliac fossæ, whether the whole pelvis is symmetrical, whether the spine is straight and the legs equal, and whether there is any deviation from the usual position of the great trochanters, or of the sacrum in relation to the innominate bones.

Internal measurements.—The most important object in internal measurement is to obtain an estimate of the true conjugate diameter, since this is the diameter of the pelvic brim which is most frequently contracted, and the contraction of which has the greatest obstetric importance. By the term true conjugate will be here understood what is sometimes called the obstetric true conjugate, namely, the line drawn from the promontory of the sacrum to the nearest point on the inner surface near the top of the symphysis pubis (E F, Fig. 16, p. 18), not the line from the promontory of the sacrum to the centre of the top of the symphysis pubis. It is the former distance alone which has any practical significance.

The distance actually measured is the diagonal conjugate (E N, Fig. 16), or sacro-subpubic diameter. From this the true conjugate has to be inferred. For measurement of the diagonal conjugate the patient may be placed on the left side, or on the back, the hips raised on a folded blanket. Two fingers, or four fingers, if the vagina is capacious enough to allow it, as in the first stage of labour, are introduced into the vagina and directed upwards behind the cervix, depressing the posterior vaginal cul-de-sac until the tip of the finger touches the sacrum (see Fig. 176). The fingers are then still raised until the angle formed by the promontory of the sacrum is recognised and the tip of the middle finger rested upon it. For this the fingers have to be directed nearly vertically upward in the axis of the trunk. The angle the diagonal conjugate makes with this axis is about 20° in the normal pelvis, the pelvic inclination to the horizon being taken as 55°. If the pelvic inclination is greater, and the promontory of the sacrum therefore higher, as it sometimes is in a flattened pelvis, the fingers must be directed still more vertically upwards. Care must be taken not to

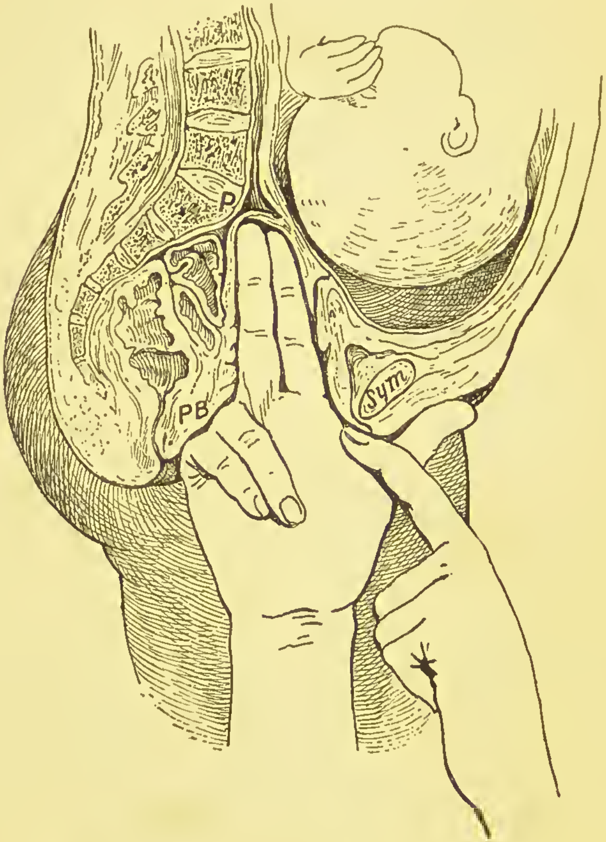

Fig. 176.—Measurement of diagonal conjugate.

mistake for the promontory of the sacrum a slightly projecting angle which sometimes exists between the first and second sacral vertebræ. The tip of the middle finger resting then upon the promontory, the hand is slightly raised, so as to press the radial side of the index finger, or the side of the hand, against the apex of the pubic arch. The point of contact is then marked with the finger-nail of the disengaged hand, the hand is removed from the vagina, the finger-nail being kept upon it, and the distance from the marked point diagonally to the tip of the middle finger measured with a rule. This gives the diagonal conjugate. It is rather difficult to mark the exact point with the nail while the finger is closely pressed against the pubic arch. It is still better, therefore, if the perceptive faculty of the radial side of the finger can be so educated that it retains the impression of the exact spot cut by the apex of the pubic arch until the hand is removed from the vagina, and the finger-nail is then placed upon this spot. If there is any doubt of the exact point, the mean should be taken of the estimates derived from several trials.

Even in the normal pelvis the promontory of the sacrum can always be reached in this way with two fingers, if the soft parts, especially the vaginal outlet, are not too resisting. In case of difficulty, the administration of an anæsthetic greatly aids the overcoming of this resistance. As a general rule, however, if the fingers can be introduced a fair distance, and the promontory cannot be reached, it may be inferred that there is no contraction of the conjugate diameter. The length of the fingers must of course be taken into consideration. In a flattened pelvis, the promontory of the sacrum can often be felt by the index finger alone, and it is then better to measure the diagonal conjugate by introducing that finger only. If the promontory can be easily reached in this way, it may generally be inferred that some contraction exists.

The diagonal conjugate (E N, Fig. 16, p. 18) being known, the true conjugate, or the side E F of the triangle E F N, has to be deduced from the two sides E N, N F. The angle E F N, between the symphysis pubis and the plane of the brim, is almost always an obtuse angle. It is evident that the difference between the sides E N and E F will be greater, the greater is the side F N, or the height of the symphysis pubis, and the greater also is the angle E F N, or the inclination of the symphysis to the plane of the brim. The average amount to be deducted from the diagonal conjugate to get the obstetric true conjugate is about two-thirds of an inch. 2/3
Corrections for individual cases cannot be made with absolute exactness, but a general estimate may be formed. The height of the symphysis may be directly measured. If it amounts to, or

exceeds, an inch and a half, the inclination of the symphysis being assumed normal, the deduction may be estimated at $\frac{3}{4}$ inch at least, instead of $\frac{2}{3}$ inch. Some increase in the deduction must also be made if it is judged that the promontory stands higher than usual, or that the direction of the symphysis pubis is more vertical than usual. In the reverse cases a deduction of $\frac{2}{3}$ inch may be rather too much, the difference being sometimes under half an inch. The difference is likely to be greatest in the case of a very greatly flattened pelvis with excessive pelvic inclination. It may then reach and even exceed one inch.

The following construction gives a more exact result (see Fig. 177). Draw a line A B equal to the height of the symphysis pubis. From the point A draw A C, making an angle of 110° with A B. From the centre B, draw a circle having a radius equal to the length of the diagonal conjugate, cutting the line A C in the point F. The length A F will be the true conjugate. For this construction, a graduated circle is required; or the angle B A C may be traced from Fig. 177. The only element of uncertainty is the magnitude of the angle B A C, which varies somewhat in different cases, but its average magnitude is about 110°. In the rachitic pelvis, it is often rather less, owing to the diminished pelvic inclination.

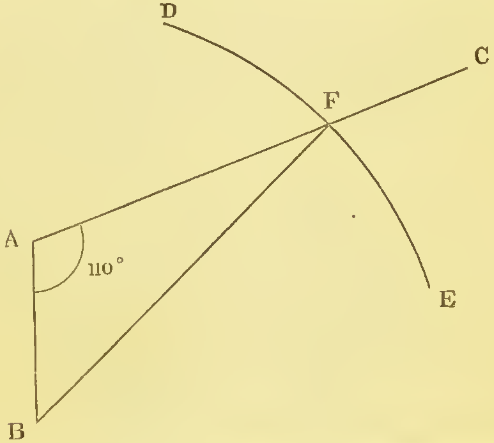

Fig. 177.—Diagram for calculation of true conjugate diameter.

Direct measurement of true conjugate.—The true conjugate itself can be directly measured by two methods, which are of great value, but can only be applied under exceptional circumstances. The first method is, just after delivery, to pass the whole hand into the pelvis within the cervix, and see how far the four fingers side by side, or the breadth of the hand, will pass up in the conjugate diameter. The point at which they are arrested is noted, the hand withdrawn, and its breadth at that point measured with a rule. In case of slight contraction only, the thumb may be added, but diameters up to 3½ inches can generally be measured without it. It is not so well to measure the diameter by separating the fingers, for it is difficult then to keep them in exactly the same position during withdrawal. This method gives precisely the conjugate diameter available for the passage of the fœtus; and this may be recorded for use in future pregnancies.

External measurement of true conjugate.—Another method is by measurement from outside; and this can be used only when the patient is not pregnant, the abdominal walls not too thick, and the abdomen not very tense. The index finger is pressed in above the pubes, and the abdominal wall carried before it, until it rests on the promontory of the sacrum (at E, Fig. 16, p. 18). The wrist is then depressed, and the point noted where the top of the symphysis cuts the finger. This gives the distance from the promontory to the centre of the top of the symphysis. Something has to be added to the distance measured for the thickness of the soft parts pushed before the finger, and something subtracted for the thickness of the pubes to get the obstetric true conjugate E F. The addition and subtraction will nearly balance when the abdominal walls are thin.

Other results of internal measurement.—The true conjugate diameter is the only dimension of the brim which can be estimated at all accurately from internal examination. A general estimate, however, can be obtained of the characters of the pelvis in many other respects; and it is in forming this estimate that the experience and judgment of the observer are of most value. The student, therefore, in every case of labour, as well as in vaginal examinations apart from labour, should take the opportunity of gaining practice in judging the usual pelvic dimensions. The chief points to be noted are the following:—Whether the promontory of the sacrum is exactly opposite the symphysis pubis; whether it forms a projection encroaching on the space of the pelvic brim, with hollows at each side of it, as in the reniform pelvis, or only forms a part of a concave or flattened wall; whether there is ample space in the hollow of the sacrum, or whether the sacrum is so flattened, without being divergent from the symphysis pubis, that lower diameters, as well as the conjugate of the brim, are likely to cause obstruction; whether the lateral space in the pelvis appears to be as large as usual; and whether the space is equal on the two sides of the promontory of the sacrum.

The measurement of the diagonal conjugate can be made in pregnancy, or even in labour, if the head is still high in the pelvis, or if it is so moveable that it can be pushed up. If the head has descended considerably into the brim, and is fixed there, even though its largest diameter may not yet have entered the brim, it may be impossible to measure the diagonal conjugate. It may still be possible, however, to ascertain whether the promontory of the sacrum encroaches upon the space of the brim or not, and to form an estimate as to the symmetry of the pelvis, and the lateral space in it.

Varieties of Contracted Pelves.

Principle of classification.—The different forms of contracted pelvis will here be classified primarily according to their shape rather than according to their causation, since it is the shape which is of main obstetric importance. It is true that each of the characteristic shapes has a special cause to which it is most frequently due, but the two methods of classification do not give exactly parallel results.

There are three forms of contracted pelvis, which are met with more frequently than the others, and are those which most usually demand operative interference. These are the generally contracted pelvis, including the allied varieties of the infantile and the masculine pelvis, the pelvis flattened without general contraction, and the generally contracted flattened pelvis.

RAL. CO PELVIS. ē INFANTILE & MASCULINE
FLATTENED WITHOUT GENERAL CONTRACTION
LLY CONTRACTED

The Generally Contracted Pelvis.

FLATTENED PELVIS

The generally contracted pelvis, or *pelvis æquabiliter justo minor*, is the rarest of the three principal forms mentioned above. It is characterized by a general diminution of all the diameters, but no deviation, or but little deviation, from their relative proportion in the normal pelvis. In its most perfect form it is seen in the pelvis of women who are very small, or actual dwarfs, but not otherwise deformed. The pelvis may then have the perfect female type, but in the case of dwarfs, the parts of the pelvis may be found united, not by bone, but by cartilage only, as in childhood. Generally, however, a pelvis which, from its general appearance, is classed as a generally contracted pelvis, is found, on minute examination, to deviate slightly from the normal shape. Sometimes the conjugate diameter is contracted in rather greater proportion than the rest, especially when rickets has existed as a cause. This kind of pelvis forms a transition towards the generally contracted flattened pelvis, and all grades between the two may exist.

The infantile pelvis.—In the majority of pelves approximating to the type of the generally contracted pelvis, the characters point to a partial arrest of development, the changes which take place in the advance from the fœtal to the adult pelvis not having taken place to the full extent. Thus the sacrum is relatively narrow, its curvature on transverse section is too great, on antero-posterior section too little, its face does not look enough downward, its posterior surface is not sufficiently sunk between the ilia, nor the whole bone in the direction of the coccyx; the pubic arch is not fully expanded; the transverse diameter of the brim does not exceed the conjugate in the due proportion. When these peculiarities are well marked, the pelvis is called infantile. The general size of the outlet is apt to be small, compared with that of the inlet, as it is in the fœtal or child's pelvis.

The generally contracted or infantile pelvis may arise from any disease or other condition which interferes with nutrition in childhood. Thus it may be the result of scrofula, cretinism, premature hard work, or bad feeding. It may also arise from a form of rickets, protracted in time but not severe in degree, so that it has the effect of interfering with bone growth without causing actual softening of the pelvic bones. A marked form of infantile pelvis, with narrow pubic arch, and relatively small transverse diameter, is associated with congenital absence of the uterus, or uterus and ovaries, but this is not of obstetric interest. It appears, however, that an infantile pelvis, though not so marked, may also be associated with that minor degree of imperfect development of uterus and ovaries, in which menstruation is scanty, and begins late in life, the cervix uteri is conical and narrow, the uterus often more anteflexed than usual, and the woman often sterile. Dr. Roper has related such a case, in which pregnancy followed incision of the cervix uteri, but delivery could only be effected with much difficulty. It has been supposed that in some cases a generally contracted pelvis is due to premature bony union of the parts of the pelvis, possibly the result of excessive muscular work in early life. In other cases no cause for the infantile form of pelvis can be discovered, and it must be ascribed to some unknown congenital tendency, hereditary or otherwise. In some cases an infantile shape of pelvis is associated with a size not below normal, growth having gone on, though development failed.

The rachitic generally contracted pelvis.—It has been already mentioned that a simply infantile pelvis may result from a form of rickets which simply impedes bony growth without causing softening of the pelvis. There is also another form of generally contracted pelvis due to rickets, in which some of the changes in shape of bones due to that disease are manifested. The iliac fossæ look forward, the relation between the Dist. Sp. Il. and Dist. Cr. Il. is altered, the latter not exceeding the former by the usual proportion, and there are signs of rickets in other bones, as in the tibiæ, but the pelvis is not flattened. This form of pelvis is generally described as due to the disease occurring comparatively late in childhood, after the child has begun to walk, and the tendency to widening and flattening being in consequence counteracted by the inward thrust at the acetabula. It must, however, be also true that the disease has been so far mild in degree, that neither the sacrum nor the iliac beams are sufficiently softened to bend. This form of pelvis is therefore to be contrasted with the triradiate or pseudomalacosteon form of rachitic pelvis (see Chapter XXX.), in which also the disease produces its effects after the child has learned to walk, but in which the degree of softening is greater instead of less than that which leads to the usual flattened rachitic pelvis.

The masculine pelvis.—In strong muscular women, rather tall in proportion to their breadth, especially those who have a somewhat masculine appearance from the growth of hair on the face, a variety of uniformly contracted pelvis is sometimes found, showing some approximation toward the male type. The bones are thick, the pelvis deep, prominences for muscles well marked, the transverse diameter too small in proportion, and the outlet comparatively narrow.

In the marked cases of general pelvic contraction all the internal diameters of the pelvis may be reduced by as much as one-fourth of their normal value. The difficulty in delivery may then be very considerable, even after the performance of craniotomy.

Mechanism of labour.—In minor degrees of contraction the mechanism of labour is not altered, except that the flexion of the head is apt to be extreme, after it has entered the brim, owing to the want of space for its longest diameter, and that the natural rotations may be impeded by excessive friction.

Diagnosis.—All the external diameters are diminished in about equal proportions, and the diagonal conjugate is also diminished. On internal examination there is found to be diminution of lateral space, but no encroachment of the promontory of the sacrum into the area of the brim. The normal relation between the Dist. Sp. Il. and Dist. Cr. Il. is unaltered, except in the rachitic form of the generally contracted pelvis.

THE FLATTENED PELVIS, AND THE GENERALLY CONTRACTED FLATTENED PELVIS.

In the former class of pelvis there is contraction of the conjugate diameter, but no notable contraction of the remaining internal diameters. In the latter, combined with the relative contraction of the conjugate, there is general smallness of the whole pelvis from failure of development. It is evident that if a full-sized pelvis were flattened, its transverse diameter would be rendered greater than normal. In point of fact, however, it is hardly ever found that the transverse diameter is greater than normal in a flattened pelvis, and frequently it is, if anything, rather diminished. Therefore, even in pelves reckoned merely as flattened, because there is no notable contraction in the transverse diameter, there is almost always, in reality, some lack of full development.

The flattened pelvis, whether generally contracted or not, may be divided into two varieties, according to the shape of the brim, the *elliptic flattened pelvis*, and the *reniform or kidney-shaped flattened pelvis.* In the former the shape of the brim resembles an ellipse flattened on the posterior side. The concavity of the sacrum on transverse section is almost or entirely lost, but is not converted into a projection. In the latter the brim is kidney-shaped (see Fig. 178, p. 522). The promontory of the sacrum has sunk so far inward toward the brim as to form a rounded prominence encroaching upon its area. This is the commoner variety of the two.

(1) ELI
(2) REN

By German authors a different division of flattened pelves is made, namely, into the rachitic and non-rachitic flattened pelvis. It is admitted, however, that the form called non-rachitic, because other characteristic peculiarities of rickets are absent, is often due to slight rickets. Moreover the division given above corresponds to a difference in the mechanism of labour, while that into rachitic and non-rachitic forms does not.

RACL
NON

Causation.—The flattened pelvis without general contraction is probably often due to slight rickets, causing some softening of the sacrum, but not marked enough to produce the general peculiarities due to the disease. The fact that some slight failure of development almost always exists is in favour of this view. The deformity is also ascribed to lifting or carrying heavy weights, such as babies, in childhood, either with or without the slight rachitic tendency. Flattening is also produced by excess in the pelvic inclination, for then the component of the body-weight which acts in the plane of the pelvic brim is increased. The excess of inclination may be due to an exaggeration of the normal curves of the spine, a condition itself often the consequence either of slight rickets, or of carrying weights in childhood, or of both causes combined. Whether or not general contraction is present, the elliptic flattened shape of the brim must be ascribed to the effect of the body-weight, without marked softening of the sacrum; when the sacrum is much softened the reniform shape is produced. Hence, as a general rule, the greater part rickets has in the causation, the more marked is the reniform shape. Sometimes, however, a distinctly rachitic pelvis, with general contraction, has the simply flattened shape either because the softening has not specially picked out the sacrum, or because the disease has shown itself more in arrest of development than in softening. The simple flattening in such a case may have been produced by carrying weights. The degree of contraction is seldom extreme in those cases where its rachitic origin is not manifested by the peculiarities in the pelvis generally produced by that disease, the conjugate diameter being rarely less than three inches.

The rachitic flattened pelvis.—This is the most typical form of rachitic pelvis. Usually there is general contraction as well as flattening, in consequence of the retardation of development produced by the disease, and, in the higher degrees of contraction, this is always the case. The bones are usually small and thin, but there may be compensatory hypertrophy in parts. Thus the thickness of the sacrum may be increased, and the difference between the external conjugate and true conjugate diameters therefore greater than usual. The brim has the reniform more frequently than the elliptic shape, owing to the softening of the sacrum itself (Fig. 178). In the rachitic pelvis, most of the changes in shape which occur in the advance from the fœtal to the adult pelvis from mechanical influences are exaggerated. The pubic arch is more widened, the relative size of the transverse diameter of the brim, and of the distance between the tubera ischii is more increased. The sacrum sinks more deeply between the ilia both toward the brim, and in

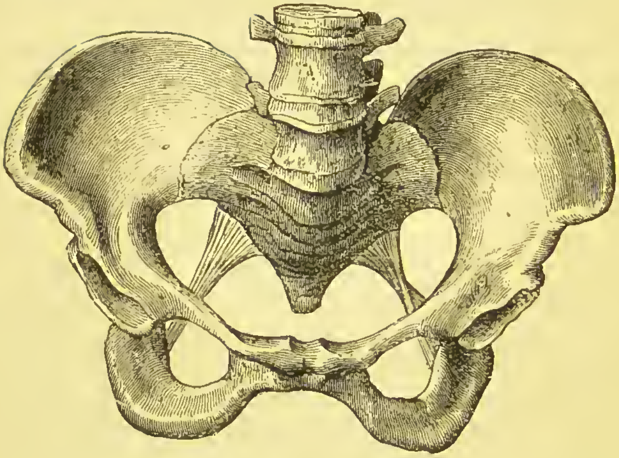

Fig. 178.—Reniform rachitic pelvis.

the direction of the coccyx. The promontory is more rotated forward, so that the anterior surface looks more downward, and the curvature on antero-posterior section is increased. The curvature on transverse section is diminished and generally converted into a convexity toward the brim.

These effects are due to the fact that the bones are softened, but not so much so as to prevent their acting as beams or levers. The softening affects chiefly the growing extremities and the cartilage about to form bone, so that the yielding takes place mainly at certain points, as between the centre and wings of the sacrum. If the softening is more extreme, affecting the whole of the bones, so that they can no longer act as levers, a totally different form of pelvis, resembling that of malacosteon, is produced (see Chapter XXX.), the acetabula being pushed inwards.

The relative widening of the pelvis, especially at the outlet, is explained by the fact that the effects of the disease on the pelvis are mainly produced before the child can walk or stand much, and that therefore the counterpressure at the acetabula has little influence. The widening then is chiefly due to the effect of the body-weight in the sitting position calling out the leverage of the innominate bones (see pp. 22—24), and to that of the counterpressure on the tubera ischii in rotating outward the lower part of the innominate bones (see p. 26). The bending inward of the lower end of the sacrum so as to increase the curvature of the bone on antero-posterior section is partly due to the resistance of the sacro-sciatic ligaments to the rotation forwards of the promontory, and to muscular action, but is assisted also by the effect of the pressure on the lower end of the bone in sitting.

The shape of the iliac fossæ is characteristic, and has been already referred to as valuable in diagnosis. They are flatter than usual, and look more forward, so that the maximum distance between the crests does not much exceed that between the spines. In cases of marked deformity, the distance between the spines is the widest diameter. This shape of the ilia appears to be partly due to arrested development, but partly also to the action of the gluteal muscles. There are other minor points by which the effect of rickets is shown, such as eversion of the edges of bone to which muscles are attached, especially those of the pubic arch, and of the ischia, and sharpness of the ileo-pectineal line.

The general effect is to produce a shallow pelvis, the transverse diameter of the brim relatively wide, but in general absolutely more or less below the normal, the outlet less contracted than the inlet in all its dimensions, and sometimes even actually expanded. This wideness of the outlet and shallowness of the pelvis facilitate the access to the fœtus in the case of difficult delivery after craniotomy. The promontory of the sacrum is not unfrequently displaced somewhat to one side in consequence of a scoliosis (lateral curvature) of the spine. The pelvis then partakes of the characters of the oblique pelvis, hereafter to be described (see Chapter XXX.).

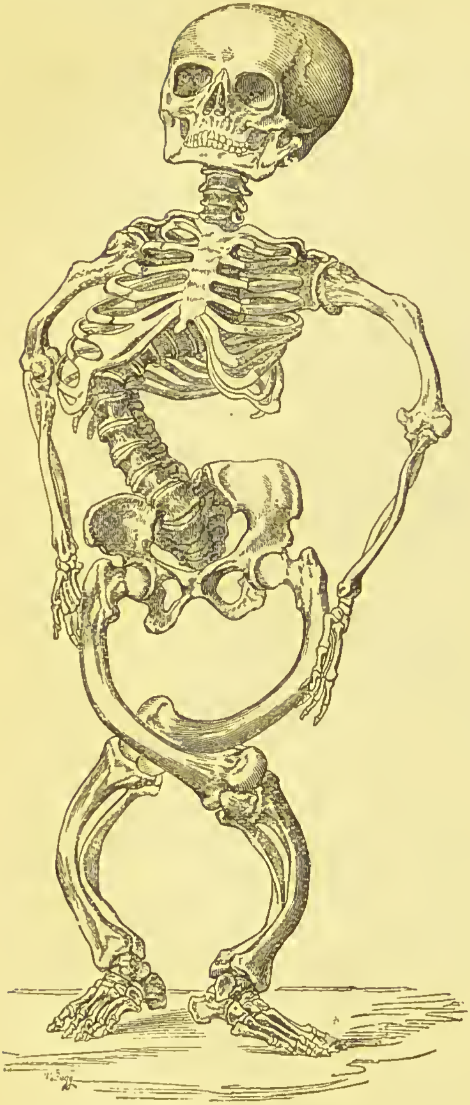

Fig. 179.—Skeleton of a rachitic dwarf with contracted pelvis.

In the rachitic pelvis the inclination of the brim to the horizon is generally somewhat diminished. This may be explained on two grounds. First on account of the sinking of the sacrum deeper toward the coccyx. Secondly, owing to the sinking of the sacrum forward into the brim, the line of action of the body-weight falls anteriorly to the sacro-iliac joints. The counter-pressures to the body-weight therefore at the acetabula or the tubera ischii, which must necessarily act in the same transverse vertical plane as the body-weight to produce equilibrium, tend to rotate the anterior part of the pelvis upward on a transverse axis passing through the sacro-iliac joints. Thus, while an increase of the pelvic inclination in any pelvis tends to cause the sacrum to sink forwards into the brim, such sinking forward has a secondary effect, tending to diminish the pelvic inclination. There is often a counterbalancing influence, tending to increase the pelvic inclination in the rachitic pelvis, namely, an exaggeration of the normal curves of the spine. But the influence of the first two causes usually preponderates.

Figure-of-eight rachitic pelvis.—In very rare cases there is a depression inwards of the symphysis pubis of a rachitic pelvis. This is ascribed to the traction of the recti muscles (see Fig. 180). In this case the brim has the shape of a figure of eight, or hourglass, but not a uniform figure of eight, for the projection inward of the sacrum is greater than that of the symphysis pubis, and the hollows at each side of it deeper. More frequently the pubis is not drawn in, but the curvature near that point is more acute, in consequence of a slight flattening opposite the acetabula, due to the inward thrust of the femora. The pelvis thus approximates to a heart shape (see Fig. 179, p. 524). Such a pelvis may be regarded as intermediate between the ordinary reniform shape and the generally contracted rachitic pelvis, and it implies an intermediate influence of standing, walking, &c.

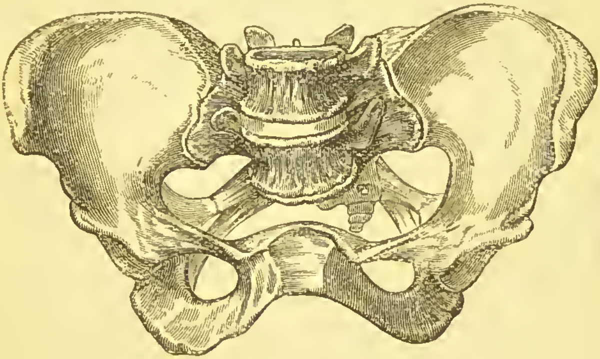

Fig. 180.—Figure-of-eight rachitic pelvis.

S

P

Mechanism of labour in the flattened pelvis.—The flattened pelvis has certain peculiar effects of its own upon the mechanism of labour. In accordance with the three dimensions of the fœtal head, there are modifications of the mode in which the head passes through the pelvis in three respects; (1) as to its rotation; (2) as to its flexion or extension; (3) as to its lateral obliquity or lateral flexion.

(1.) *Rotation.*—In pregnancy the head will generally lie with the occiput somewhat forward, on account of the adaptation of the whole fœtus to the shape of the uterus and of the abdominal cavity. But, on the rupture of the membranes, the head will enter or attempt to enter the brim with its antero-posterior diameter in the longest diameter of the brim, that is to say, in nearly a transverse position, whenever the space is not sufficient to allow it to enter freely in an oblique position. In the elliptic flattened pelvis, the antero-posterior diameter of the head will be almost exactly transverse. In the reniform flattened pelvis, the main part of the space at the sides of the pelvis is posterior to a transverse line bisecting the conjugate diameter. Hence the broader or occipital end of the head will find most space by turning somewhat backward (see Fig. 181, p. 528). If there is sufficient transverse space in the pelvis, and the shape is reniform, the head generally deviates bodily somewhat toward that side of the pelvis toward which the occiput is directed, so as to bring the broad biparietal diameter into the freer lateral space, and get a smaller diameter of the head, one as near as possible to the bitemporal, into opposition to the contracted conjugate diameter (Fig. 181). It is only when the head is very small relatively to the transverse diameter of the pelvis that it can deviate so far to one side as to allow the bitemporal diameter itself to enter the conjugate. Thus at the early stage of labour there is often some rotation of the occiput *backwards.* The antero-posterior diameter remains in the same direction until the superior strait is passed. Then, if flexion occurs, the occiput is rotated forwards as usual by the inclined plane of soft parts.

(2.) *Flexion and extension.*—Before labour the head is lying above the brim, if contraction is at all considerable. The head not entering the brim easily, both occiput and forehead are detained above its level, and therefore the usual flexion cannot take place. Owing to the shape of the head, the anterior fontanelle will be more within reach than the posterior. The head at this stage is therefore more extended than usual. The further course of affairs depends upon the exact shape and size of the pelvis, and the relation of these to the size and shape of the head, especially as regards the prominence of the parietal tubera. In the reniform pelvis, when the lateral spaces are large, as in the case of the flattened pelvis without any, or with only a slight degree of, general contraction, it generally happens that, when the head is beginning to engage in the brim, the diameter most tightly gripped is that opposed to the contracted conjugate. The biparietal diameter in the free space at the side meets with less resistance. The greatest resistance is then anterior to the occipital condyles, and therefore produces flexion, the head rotating in some measure around the diameter gripped in the conjugate until the occiput is well engaged in the pelvis. In this case, therefore, the head passes the brim, if able to pass it at all, by a movement of flexion.

The mechanism is different in the case of the elliptic flattened pelvis, and also in some cases of the reniform pelvis, when the reniform shape is slightly marked, and the hollows at each side of the promontory not large. The diameter which meets with most resistance is then frequently the biparietal, that which is engaged in the conjugate not fitting so tightly. The points of greatest resistance are then *behind* the line of propelling force passing through the condyles, and therefore the resistance produces *extension*. The head then passes through the brim, if able to pass, in a position of somewhat greater extension than it had while resting above the brim. There is sometimes evidence of this in a groove of depression on the parietal bone caused by the pressure of the promontory as the head passes. When the passage takes place in the position of extension, this groove runs nearly parallel to the coronal suture and posterior to it. Otherwise it is obliquely inclined towards, or crosses, the coronal suture. It is obvious that it must depend greatly upon the relative size of the biparietal diameter, and the degree to which it can be diminished by moulding, whether the biparietal diameter or that engaged in the conjugate meet the most obstruction. These vary greatly in different heads.*

The extension of the head is generally limited by the capacity of the transverse diameter of the pelvis to admit the long diameter of the head when increased by extension. In a generally contracted flattened pelvis, which is not wide enough to admit the long diameter unless the head is flexed, the head must either pass by the movement of flexion, or else remain arrested.

After the head has passed the brim, flexion is usually produced by the resistance of the soft parts, and the occiput rotates forwards in the usual way.

(3.) *Lateral or biparietal obliquity.*—In a fœtal head before moulding, the biparietal diameter is generally greater than adjacent oblique diameters drawn from a point a little above the parietal tuber on one side to a point a little below it on the other (which may be called subparieto-superparietal diameters). The same is true, though to a less degree, of the maximum transverse diameter in other parallel sections of the head. Hence the head will pass through a smaller space if tilted a little sideways, so that one parietal tuber passes in advance of the other. Now, if a body is pushed through a narrow passage by its posterior pole, and is so shaped that a tilting one way or other will facilitate its passage, the resistances are certain to effect that tilting. The body is in unstable equilibrium until the tilting is produced, and the slightest variation in the direction of the propelling force or the amount of friction will bring it about. The principle may be illustrated by the experiment of trying to push an egg through an elastic tube with its long diameter exactly across the axis of the tube. The egg is certain to turn so as to bring its shorter diameters into coincidence with the diameters of the tube. Similarly the head can never by any possibility continue to advance in a position of brow presentation, with its longest mento-occipital diameter thrown across the parturient canal, but, if it advances at all, the presentation is always converted into either a face or a vertex (see pp. 228, 239). It is in the same way that lateral tilting of the head is produced by the resistances whenever there is pressure at the ends of lateral diameters and a mechanical advantage is thus to be gained.

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* By Litzmann, Playfair, Spiegelberg, and Lusk only the former of these modes of transit, by Schrœder and Goodell only the latter is described as being the usual one in the flattened pelvis.

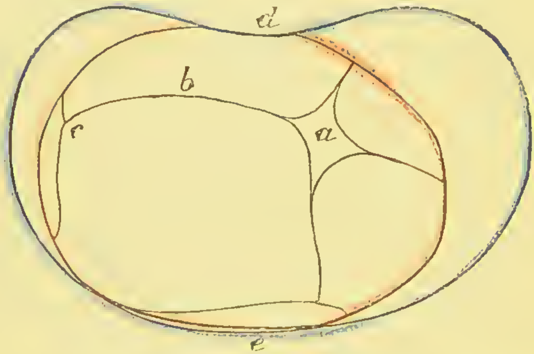

Fig. 181.—Engagement of head in brim of flattened pelvis viewed from below in the axis of the brim :—*a*, anterior fontanelle ; *b*, Sagittal suture ; *c*, posterior fontanelle ; *d*, promontory of sacrum ; *e*, symphysis pubis.

It may also be shown that the shape of the head is such that, if arrested above the brim, it is in a position of unstable equilibrium until it has been tilted to one side or other to a greater degree than that which will give the greatest mechanical advantage when the biparietal diameter is actually engaging in the brim. When the head is engaging in the pelvis the greatest mechanical advantage is gained by a tilting of not more than about 12° or 15°, even before moulding. When the head is arrested above the brim, the tilting may proceed to as much as 20° or 25°, though such an amount of obliquity is not a mechanical advantage, but rather the contrary.

In the flattened pelvis, it is found that the sagittal suture is generally displaced towards the promontory of the sacrum, so that the anterior parietal bone enters the brim in advance of the posterior, and the child's head is flexed towards its posterior shoulder (Fig. 181).

This is called Naegele-obliquity, because Naegele described it as existing in normal labour. It remains to explain why the tilting is generally in this direction rather than the opposite.*

One reason may be posterior obliquity of the uterus in reference to the axis of the brim. Frozen sections show such an obliquity, and R. Barnes contends that it is the normal condition. In frozen sections, however, it is due, in great measure, to the prolonged effect of gravity on the corpse lying on its back, and to the chest being in a position of expiration, whereas in a pain it is in one of deep inspiration. It is probable therefore, that the usual assumption that the axis of the parturient uterus normally coincides with that of the brim is not far from the truth. But the slightest degree of posterior obliquity is sufficient to determine the direction of the tilting, which the resistances then increase. The effect is produced in the following way. The component of the oblique force acting perpendicularly to the axis of the brim pushes the condyles *forward ;* this calls out a reaction of the anterior pelvic wall directed *backward,* but passing through the centre of the head or nearly so. Thus is produced a " couple " or pair of equal and opposite forces, not in the same straight line, tending to tilt the sagittal suture backward, and produce Naegele-obliquity.

Another reason is probably the effect of friction against the sacral promontory. It might at first sight be supposed that friction would be greater at the anterior part of the pelvis, where the surface of contact is greater. A mathematical consideration of the question, however, shows that exactly the contrary is the case.† This result depends upon the fact that the curvature in the plane of the brim of the head where it is in contact with the anterior pelvic wall is less than that of a circle having as its diameter the conjugate diameter of the pelvis. Hence the posterior side of the head is retarded most by friction against a projecting promontory. It is retarded still more if the promontory makes a depression in the head by its pressure. A kind of ledge is then formed, which offers a greater resistance than that of friction proper.‡

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* See papers by the author " On the Occurrence in Normal Labour of Lateral Obliquity of the Fœtal Head," Obstet. Trans., Vol. XVII. ; and by Robert Barnes, " On the Mechanism of Labour with Reference to Naegele's Obliquity," Obstet. Trans., Vol. XXV.

† It must be remembered that friction is not increased by increasing the surface of contact. If the surfaces are plane, the total friction remains the same, the friction being proportional to the pressure over each small element of area.

‡ By Goodell it is stated that the sagittal suture is slightly displaced forward at the earlier part of its passage, before its main displacement backward begins. Matthews Duncan held the same view. This would imply that the anterior side of the head is at first most retarded, as was found to be the case in the experiments of Matthews Duncan with an after-coming head. No satisfactory mechanical explanation has hitherto been suggested for this. It is possible that, contact being wider in front, a

There are exceptional cases in which the opposite of Naegele-obliquity occurs, and the sagittal suture is displaced forward. An anterior obliquity of the uterus, as from pendulous abdomen, tends to produce this result when the resistances come into play.

In general the maximum degree of Naegele-obliquity is observed, as according to the above explanation it ought to be, when the head is arrested above the brim. In such a case I have found the sagittal suture within an inch of the promontory. If considerable before, it becomes diminished as the head enters the brim, being reduced more nearly to that degree which is mechanically advantageous. The extra resistance, from friction, or from friction and depression, caused by the sacral promontory, tends however to maintain or to increase the obliquity beyond the advantageous point. The obliquity may be reduced also, during a slow passage, through shortening of the biparietal diameter from moulding. But some degree of obliquity is generally maintained till the superior strait is passed. Then when the head meets the inclined plane of the pelvic floor, its advanced part is pushed forward under the pubic arch, and the opposite obliquity is so produced as in normal labour. Thus the lateral flexion of the head toward the posterior shoulder is at this stage converted into lateral flexion toward the anterior shoulder (see p. 189).

When it is said that lateral or biparietal obliquity is produced by a rotation of the head upon its antero-posterior axis, it is not meant that the rotation takes place without a concomitant advance of the head, or that one side of the head actually recedes. In general, one side is merely retarded more than the other. But in some cases the rotation may imply an actual recession of one side of the head, as when lateral obliquity is produced when the head is completely arrested above the brim.

In some cases, again, when the resistance at the promontory is unusually great, in consequence of a depression being produced in the head, the posterior side of the head may be actually arrested, while the anterior is advancing. The movement may then be regarded as a rolling upon the sacral promontory. When the depression of the head is found to be round, it is a sign that such an arrest of the posterior side has taken place. In the commoner case, in which it forms a groove, there has been merely retardation. A spoon-shaped depression indicates an intermediate condition, probably

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more extensive fold of skin may be pushed up there than by the sacral promontory, and that this may cause the greater retardation, before the head is tightly enough engaged for friction proper to have much effect. No other authors, however, describe this primary displacement of the sagittal suture forwards, and I have generally found it displaced backwards when first observed.

complete arrest of the posterior side during a part only of the passage.

It is sometimes stated that in the earlier part of the passage the head rotates or revolves upon a transverse axis passing through the sacrum, in the latter part upon one passing through the symphysis pubis. This, however, is only a graphic and popular mode of representing the most striking part of the motion of the head, and is not strictly accurate, since it disregards other parts of the motion, namely, all rotations except that in the antero-posterior plane of the pelvis.*

Path of the centre of the head.—In the flattened pelvis, in consequence of the displacement forward of the sacral promontory, the centre of the pelvic brim is displaced forward to half the same degree, also the pelvic inclination is sometimes increased, although in the rachitic flattened pelvis it is generally diminished (see p. 524). From both these causes the axis of the pelvis brim may be inclined more forward than usual, and the axis of the uterus has then usually a posterior obliquity in reference to the axis of the brim, even when the fundus is thrown forward in a pain. The head being then kept back by the anterior uterine wall, its centre will lie at first behind the axis of the brim (A O, Fig. 16, p. 18). When this is the case its centre will have to describe a curve having its concavity backward at its entrance into the brim, before proceeding along the nearly straight portion of the pelvic axis (A B. Fig. 16, p. 18). This curve has been described by R. Barnes under the title of the "curve of the false promontory," and more recently under the title of "Barnes' curve," as being followed by the head in normal labour as well as in the flattened pelvis. It is drawn by Barnes as a semicircle, having its centre at the sacral promontory, and the so-called curve of Carus as another semicircle having its centre in the symphysis pubis. But it has already been shown that the normal path of the head does not approximate to an arc of a circle except in the lower part of its course through the soft parts (see pp. 18, 19). So the "curve of the false promontory" is only followed for a short space, and ceases when the centre of the head reaches the plane of the brim at A[*] (Fig. 16). From that point the path is for some distance nearly a straight line, as in the normal pelvis. In a normal pelvis it does not appear that the centre of the head lies initially behind the axis of the brim (A O, Fig. 16). Even in the flattened pelvis it does not necessarily do so. It does not, when the pelvic inclination is notably lessened, as it generally is in rickets,[†] nor when the uterus is anteverted from want of room in the abdomen. In such cases no "curve of the false promontory" is followed at all, but the path of the head may be, at first, nearly the axis of the brim, or even a curve having its concavity forward, especially when, at the commencement of labour, the head lies far forward, overhanging the pubes, being pushed forward by a prominent lumbar curve.

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* By Matthews Duncan a distinction was made between rotations of the head or body of the fœtus on its own centre, and what he called "revolutions," that is to say, rotations on an external axis. ("On the Rotations and Revolutions of the Fœtus," Obstet. Trans., Vol. XXV.) The word "revolution," however, is more appropriately applied to the path of the centre of a body, independent of any rotations that may take place around that centre, as, for example, in speaking of the revolution of a planet about the sun. In mechanics the word "rotation," and not "revolution," is used, if it is intended to represent the *whole* motion of a body, whether the axis of rotation is internal or external. If the motion is all in one plane, it is only two different ways of describing the same thing to say that a body is rotating round an external centre of instantaneous rotation, or to say that it is rotating in such or such a way round its centre, while its centre is moving in such or such a path.

But this is not the case when the motion is in three dimensions, like that of the fœtus. The only accurate mode is then to describe the path of the centre of the body (or any other convenient point within it), and the rotation or rotations about that centre. The component rotations in three rectangular directions may be combined into a single resultant rotation; but this cannot be combined with the movement of translation into a single rotation about an external axis, unless the two happen to lie in the same plane. In the case of a body like the fœtus, moving in all directions under the action of various forces, the chances are infinity to one against this being so, except in the case in which the body is rolling. As already mentioned, the motion of the fœtal head may sometimes be a rolling motion. There is then an axis of instantaneous rotation passing through a point on its surface, and constantly changing its position. Otherwise no axis of instantaneous rotation exists, and the probability is also very great against its being even an approximate representation of the whole motion to call it a rotation or "revolution" about an external axis. The principle here described is one simply of solid geometry, although it is used as a basis in the dynamics of rigid bodies. (See Routh: "Treatise on Rigid Dynamics," Chapter V.) The conclusion here stated may thus be summarised:—(1.) No axis of instantaneous rotation (the "revolution" of Matthews Duncan) exists for a moving body, unless the movement is limited to one plane; (2.) The movement of the fœtal head is not limited to one plane, unless in the exceptional case when the movement is a rolling one; and in this latter case the axis of instantaneous rotation is not external, but passes through a point on the surface of the head.

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[*] It is held by R. Barnes that, even in normal labour, the centre of the head is constrained to follow "Barnes' curve" still further, and is guided backward into the hollow of the sacrum, by what he calls the anterior or uterine valve, that is to say, by the anterior lip of the os, extending lower over the head, in reference to the plane of the brim, than the posterior. This implies a displacement backwards of the os uteri in reference to the axis both of the brim and of the uterus, and there is no evidence that this exists normally. The anterior lip of the os is indeed often more noticeable than the posterior as overlapping the head, but generally only because the examining finger first impinges upon it, the direction of the vagina being nearly at right angles to the axis of the brim. In Braun's frozen section (Fig. 73, p. 156) the anterior lip of the external os is notably higher than the posterior in reference to the plane of the brim, and not lower, as represented in R. Barnes' diagrams. This is explained, as a normal condition, by the drawing up in labour of the anterior pelvic triangle (see p. 159). It appears that it is only when full dilatation of the os is delayed some time after the rupture of the membranes, and after the descent of the head near to the pelvic floor, that the anterior lip of the os may be sometimes pushed lower than the posterior, in reference to the plane of the brim, by the occiput, which is descending in advance of the forehead, in consequence of the flexion of the head.

[†] In R. Barnes' figure showing the curve of the false promontory (Lectures on Obstetric Operations, p. 74), the inclination of the brim is represented as increased in rickets, although, in the sectional views of the several pelves (op. cit., p. 286), it correctly drawn as diminished.

Mechanism of labour with the after-coming head.—The long diameter of the after-coming head enters the longest diameter of the pelvis in the same way as that of the fore-coming head. In this case, also, the head may pass either in flexion or in extension, according as the biparietal diameter, or that engaged in the conjugate, is most resisted. But the tendency to extension is generally increased by the traction which has to be made in order to bring the head through the brim. On account of the posterior position of the condyles, the traction force tends to bring down the occiput most. The occipito-mental diameter may thus be thrown across the transverse diameter of the pelvis, and be unable to pass, especially if the pelvis is generally contracted as well as flattened.

Lateral obliquity will also generally occur in the passage of the after-coming head. Usually the posterior side is most retarded by the promontory of the sacrum for the same reason as before, especially when the expulsion is effected by the natural powers. In experiments made with an after-coming head and a wooden pelvic brim, with various degrees of flattening, Matthews Duncan* found that there was first a deviation of the base of the skull forwards, and afterwards backwards, the direction of traction being perpendicular to the brim. This implies, first, a retardation of the anterior side, then a more important retardation of the posterior.†

Diagnosis.—With a rachitic pelvis there will usually be some signs of the disease in the body generally. The stature will be short, especially the limbs ; the tibiæ perhaps bowed or thickened. As regards the pelvis, the most valuable sign of rickets is the change of relation between the Dist. Sp. Il. and Dist. Cr. Il. already described (p. 511). There is usually a depression in the sacral region between the ilia, in consequence of the sinking of the sacrum, and the anus looks more backward than usual. General contraction will be revealed by general diminution of the external diameters, as well as by want of space detected on internal examination. The most important sign, as regards the probable difficulties of delivery, is the estimate of the diagonal conjugate diameter (see p. 513), and the calculation from this of the true conjugate. This is especially the case when the pelvis is flattened only, with little or no general contraction, whether rickets has anything to do with the causation of the deformity or not.

When labour has commenced, the existence of disproportion of some sort is indicated by the head remaining high above the pelvis, or by its not descending upon the os uteri to continue the dilatation, when dilatation has progressed satisfactorily up to the time of the rupture of the membranes. If in addition the sagittal suture is found to remain in a nearly transverse position, or with the occiput directed a little backward, a flattened pelvis may be suspected. A marked degree of Naegele-obliquity, or displacement of the sagittal suture backwards towards the promontory, also usually indicates a flattened pelvis. The projecting promontory of the sacrum, if one exists, may then usually be felt.

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* Obstet. Trans., Vol. XX.

† For a possible mechanical explanation of the former, see note, p. 529.

NOT DESCENDING
AL SUTURE TRANSVERSE
UT BACKWARDS
= FLATTENED PELVIS.

RARE FORMS OF FLATTENED PELVIS.

The pelvis of double congenital dislocation of the hips.—Although this anomaly has been generally called a dislocation, it is in most cases a fault of development, no acetabulum being formed in the proper situation, but the head of the femur resting upon the dorsum of the ilium, behind and above its natural situation. Some have supposed that the condition may result from rupture of the ligamentum teres, through traction upon the leg in pelvic presentations.

Resulting changes in the pelvis.—It might be supposed, at first sight, that, the points of application of the reactions to the body-weight through the heads of the femora being displaced backward, the pelvic inclination would be diminished, to maintain the balance of the body. In point of fact, however, it is found that the pelvic inclination is *increased*, and that the balance is maintained by an increased lordosis of the lumbar vertebræ, by which the trunk and shoulders are thrown back. The reason of the increase of the pelvic inclination is, that a pressure backward on the anterior half of the pelvic ring is exercised by the ilio-femoral ligaments, and the iliaco-psoas muscles, in consequence of the displacement backward of their attachment to the femora. Assuming that it is not compensated for by a diminution of pelvic inclination to preserve the balance, the displacement backward of the heads of the femora itself tends to *increase* the pelvic inclination. For the posterior half of the pelvic ring is in consequence pushed up more by the pressure of the femora, and the anterior half less, than usual. In consequence of the weight being transmitted more than usual through the posterior half of the pelvis, the anterior half is found to be lighter and more slender than in the normal pelvis.

OSI

In consequence of the increase of the pelvic inclination, a greater proportion of the body-weight acts in the plane of the brim, the leverage exerted on the innominate bones is increased, and the inward thrust of the heads of the femora acts not at the acetabula but on the dorsa of the ilia. It therefore renders the iliac fossæ more upright, but has less tendency than usual to resist the widening of the pelvis. The tendency to widening is also increased by the traction of the ilio-femoral ligaments and the attachment of the iliaco-psoas muscles, which are directed more outward than usual. Hence arises a moderately flattened pelvis, enlarged transversely at the brim and still more at the outlet, the pubic arch being wide, and the tubera ischii far apart. It rarely causes difficulty in parturition, there being no general contraction associated with the moderate flattening.

The split pelvis.—The split pelvis, in which there is no bony union between the pubes, but only a fibrous band, also generally arises from a fault of development. It is usually associated with ectopia vesicæ and imperfect development of the sexual organs, and is therefore of little practical obstetric interest. It is, however, of some importance in illustrating the action of the mechanical forces concerned in pelvic development.

Resulting changes in the pelvis.—The separation of the anterior ends of the innominate bones necessarily renders the pelvis relatively wide. The widening forces, namely, the reactions to the body-weight at the acetabula, and at the tubera ischii, therefore act at an increased advantage (see p. 508), and the result is a wide slightly flattened pelvis. The tension at the symphysis pubis is not abolished, but is maintained by the fibrous union, as is shown by the fact that the separation does not go on indefinitely increasing.

General Effects.

Since the generally contracted and the flattened pelves are those which most frequently lead to practical difficulty, certain general effects of these commoner forms of contraction will here be considered.

Effects of pelvic contraction upon pregnancy.—In the earlier months, if there is a projecting sacral promontory, and if the uterus is retroflexed or retroverted, the pelvic contraction may favour incarceration, the promontory preventing the fundus uteri from readily rising out of the pelvis into the abdomen as it enlarges. In the later months, the uterus, with the fœtus, generally is situated higher than usual in the abdomen, if the head is too large to lie low within the pelvis. Hence deviations of the uterus, especially anteversion, are commoner than usual, especially when the stature is short, as in rachitic patients, and the abdomen does not afford room enough for the uterus in its usual position. Such deviations become progressively more marked in repeated pregnancies, from the increasing laxity of the abdominal walls. Malpresentations are at least five times as common as with a normal pelvis. This result depends partly upon the frequent obliquity of the uterus, partly upon the high position of the head, the consequent readiness with which it deviates to one side, and the ease with which the irregular pelvis allows the descent of a hand, arm, funis, or other part.

Effects of pelvic contraction upon labour.—In the early stage of labour the head is generally high above the brim. The bag of membranes may then protrude more deeply, in a sausage-like form, through the os, owing to the head not descending, and the liquor amnii being unimpeded. After the rupture of the membranes, dilatation of the cervix, if incomplete, ceases, if the presenting part is unable to descend and continue it. The cervix may even contract again to some extent. Nearly the whole of the liquor amnii quickly drains away if the presenting part is unable closely to fill the lower segment of the uterus. For a very short time after rupture of the membranes, if the head cannot enter the brim, the pains may be less vigorous than usual, from a lack of reflex stimulus through pressure on the cervix. But before long the uterine wall being more stimulated than usual by the pressure of the fœtus, the pains assume an expulsive character, even if the rupture of the membranes has taken place before the dilatation of the os has proceeded far.

The further course of labour depends greatly upon the strength of the uterine muscle and the character of the pains. If these are vigorous they are stimulated, up to a certain point, by the resistance encountered. The retraction of the thick muscular portion of the uterus (see p. 439), and thinning of the distensible portion, especially the cervix, then take place rapidly, and there is danger of rupture, if the obstacle is insuperable. In moderate degrees of contraction, the fœtus may be forced through the brim by the vigorous pains. If the disproportion is too great to allow this, and rupture does not occur, eventually exhaustion supervenes. The pains may die away for a time, and again return, or the uterus may at once pass into the state of continuous action (see p. 439), and the constitutional signs of protracted labour, which have been already enumerated (see pp. 438—440), appear. If the uterine wall is initially thin, or the pains weak, the stage of exhaustion comes on much earlier.

Effects of pressure on the soft parts.—Injuries to the soft parts are almost invariably caused by the head, not by other parts of the fœtus. They are produced rather by prolonged pressure than by rapid transit, and therefore occur chiefly in head presentations. The uterine wall, generally the supra-vaginal portion of the cervix, may be bruised and injured by pressure against the promontory of the sacrum, against the pelvic wall generally, or against any other projections which may exist. Hence may follow hæmorrhages in its substance, and subsequent inflammation. Sometimes the injury produced may be the starting point of rupture in labour. More frequently, a necrotic process takes place afterwards, especially over the site of the sacral promontory. The injury is most extensive on the surface of the utero-vaginal canal where the tissue is exposed to the access of air and germs, and rarely causes perforation through the peritoneum.

Injuries to the anterior wall of the genital canal, from pressure against the pubes, affect the vagina much more often than the cervix. Thus vesico-vaginal fistula is much more common than utero-vesical fistula. Hence it is rare that sloughing in this situation results from pelvic contraction so great as to arrest the head above the brim. It more commonly arises when the head has partly entered the vagina, and is long detained in that position, either from moderate disproportion or uterine inertia, while no artificial assistance is given. Here also the lesion is most extensive on the vaginal surface. It very rarely arises from immediate laceration in delivery, instrumental or otherwise, almost always from a gradual process of sloughing afterwards. The fistula then becomes manifest, by the escape of urine, only after the lapse of some days. Sloughing may also occur after prolonged pressure in other parts of the vagina. This may lead to general cicatricial contraction in the end. If the slough is posterior, a recto-vaginal fistula may be formed, but this is much more rare than a vesico-vaginal fistula. Injuries to the perineum and vaginal outlet, which may be promoted by contraction of the bony outlet, especially of the pubic arch, will be considered hereafter (see Chapter XXXVI.).

Effects of pressure on the child's head.—The caput succedaneum or scalp tumour arises from a limited portion of the head being unsupported, while the rest is subject to pressure. It may be produced while the head is at or above the brim in contracted pelves, but, in consequence of the mechanism of its production, it is not so readily produced when the obstacle lies in one diameter only of a flattened pelvis, as when there is uniform contraction, or when the obstacle is due to rigidity of soft parts. The presence of a considerable caput succedaneum indicates not only the existence of resistance, but that the pains are effective, and is therefore not altogether unfavourable when pelvic contraction is known to exist.

The injuries to the child which may result from contracted pelvis will be described hereafter.

Prognosis in contracted pelves.—Pelvic contraction in the more extreme degrees is fatal to the child, unless delivered by Cæsarian section, and very dangerous to the mother. Even in less extreme degrees of contraction the risk to the mother is greatly increased from the exhaustion consequent upon prolonged labour, from the access of air to the uterus consequent upon the total escape of the liquor amnii or the performance of operations, from the injury to the soft parts from pressure between the head and the pelvis, or caused by the operations necessary to effect delivery. The bruised and injured soft parts become inflamed, and the inflammation is liable to assume a septic form, and extend to the peritoneum or affect the general system. The risk is greater the nearer the injured parts are to the peritoneum. The prognosis to the children is much more unfavourable. Many die from asphyxia in consequence of the prolongation of labour, and the excessive pressure.

Spiegelberg* records the mortality to the mothers with contracted pelves in his practice as 7·9 per cent., and that of the children as 32 per cent.

Treatment of generally contracted and flattened pelves.—Contracted pelves may be divided into four classes in reference to treatment :—(1.) Those in which delivery of a living child at full term by the natural powers, or by the aid of forceps or version, may be expected. (2.) Those in which delivery of a living and viable child by induction of premature labour is probable, but not that of a living child at full term. (3.) Those in which a living child cannot pass through the pelvis, but a child can be extracted after embryotomy without great risk to the mother. (4.) Those in which delivery through the natural passages is impossible, or involves as great or greater risk than the performance of Cæsarian section.

No very positive line of demarcation can, however, be drawn between these classes. Much depends upon the size of the child's head, and this cannot be accurately measured before delivery. Moreover, there is liability to error even in the estimate of the conjugate diameter by skilled observers up to a quarter of an inch or more, and other diameters can still less be measured accurately. Thus it happens that, on the one hand, cases are recorded of a living child at full term passing a conjugate diameter of only $2\frac{3}{4}$ inches, while in other cases, craniotomy proves necessary with a conjugate of as much as $3\frac{1}{2}$ inches. Again, the inferior limit of space through which delivery by craniotomy should be attempted is very variously estimated by different authorities, and has been much modified by recent improvements in Cæsarian section. Hence it is necessary not only to make careful measurements, but to judge by the history of former deliveries, especially in deciding the question whether or not to undertake the induction of premature labour.

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* "Lehrbuch," 2nd ed., p. 428.

In cases of flattened pelves having a conjugate of $3\frac{1}{2}$ inches or more, it may be expected that delivery will be effected by the natural powers, provided the pains are strong enough. These form the majority of the whole number of cases of contracted pelvis. Unless the head is unusually large, the conjugate diameter exceeds the diameter of the head likely to engage in it, and moreover some diminution of the corresponding diameter of the head from moulding is to be expected. Hence, in the early stage of labour, an expectant treatment should be adopted. In this, as in all cases of pelvic contraction, much pains should be taken to avoid rupture of the membranes before full dilatation of the os. The patient should be kept lying down, and restrained from making premature bearing down efforts.

After rupture of the membranes, care should be taken to correct any anteversion of the uterus or other deviation from the axis of the brim. If pains are feeble, it is often useful to keep the patient on her back, so that gravity may assist the advance of the fœtus, and reflex stimulus be increased. Moderate external pressure may also be used during the pains. A certain influence can be exercised on the flexion or the extension of the head by the position of the patient. Obliquity of the uterus tends to cause advance of that part of the head opposite to the direction of the obliquity. Hence, if the occiput is directed as usual to the left, and if it can be made out that the diameter of the head engaged in the conjugate is most tightly gripped, and that therefore, the head has a better chance of passing by flexion than by extension (see p. 526), the usual left lateral position is injurious. If the patient is placed on her right side, and right obliquity of the uterus thus encouraged, the descent of the occiput will be favoured.

A reasonable time should be allowed, to see the effect of the natural powers, especially if progress is being made, but no oxytocic, as ergot, should be given. If the pains begin to fail, or symptoms of exhaustion, especially considerable acceleration of pulse, appear, assistance should be given. The greater is the apparent disproportion between the fœtal head and the pelvis, the less time should be allowed to elapse to exhaust the patient's powers, because it is then more likely that she will have to undergo afterwards the ordeal of a difficult extraction; and the more she is exhausted beforehand, the worse will her prospects be. The fœtal heart should also be watched. Any marked diminution of its rate, especially if accompanied by feebleness of sound, should be an indication for interference in the interest of the child. Comparatively early interference is especially indicated when, after rupture of the membranes, the head cannot descend upon the os to continue the dilatation, though even then a reasonable time may be allowed to see if the head will engage in the brim. If pains appear to be so violent as to threaten rupture of the uterus, especially if no advance is being made, interference should not be delayed.

With a flattened pelvis having a conjugate between 3½ and 3 inches, a certain time may also be allowed to nature, to see if the head will engage in the pelvis, but assistance should here be given earlier, since there is less likelihood of delivery being completed by the natural powers with a full-term child. If the pelvis is generally contracted, the same rule will apply with a conjugate up to 3½ inches; and even with such a conjugate, craniotomy sometimes becomes necessary.

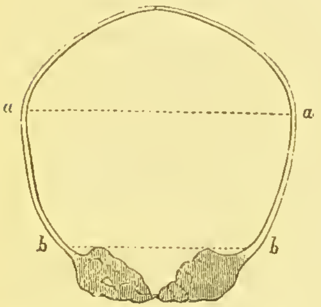

Fig. 182.—Transverse section of fœtal skull. *a, a.* Bi-parietal. *b, b.* Bi-mastoid diameter.

Choice between forceps and version.—Much controversy has taken place on the relative merits of the high forceps operation and version in the flattened pelvis, and very diverse views are still held on the subject. In Germany and America version has generally been preferred. In this country the use of forceps has held its ground better.

For extraction through a flattened pelvis, forceps have two great advantages:—(1.) A much greater force can be used than can be applied to the neck without risk of injuring the spinal cord.* (2.) The extraction may be made gradually, while the extraction of an after-coming head must be effected in a minute or two, if the child is to be saved. Against these are to be balanced the following disadvantages:—(1.) In the high forceps operation the blades are generally applied nearly in the transverse diameter of the pelvis; and, even if any other mode of application is attempted, the blades naturally tend to fall into such a position. The compression thus exercised upon the head in the transverse diameter of the pelvis tends to increase all its other diameters, especially that engaged in the conjugate, and so to cause increased resistance there. This objection will have less force if the blades of the forceps have sufficient curve to hold the head without much compression, and leave a considerable space (such as $3\frac{1}{4}$ inches) between them at the widest part, even if the handles are completely closed. (2.) The same force of compression tends to turn the long diameter of the head out of the transverse into an oblique pelvic diameter. (3.) It is generally stated as another objection that the compression tends to cause flexion. This, however, is not in all cases a disadvantage, if the flexion is produced by rotation on the diameter engaged in the conjugate, for this may be the best mode of passing the brim (see p. 526). It will be a disadvantage only if the bi-parietal diameter is brought nearer to the middle line, not if the bi-temporal diameter is brought nearer to the side of the pelvis where the occiput lies. The latter will generally be the case, the whole head sliding somewhat in the direction of the occiput, where there is most room. The former effect, however, may be produced to the extent of the thickness of one blade of the forceps, if there is scanty space in the transverse pelvic diameter.

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* In experiments on the fœtus at term, Matthews Duncan found that the spinal column gave way under tensions of from 90 to 122 pounds, and that decapitation took place under tensions of from 91 to 141 pounds ("Mechanism of Natural and Morbid Parturition," p. 136). A premature fœtus might be expected not to endure so much.

The comparative advantages of version are the following :—(1.) The head naturally adapts itself to the pelvis in that position in which it can find most room ; (2.) The second advantage depends upon the shape of a vertical section of the head. In Fig. 182, p. 540, a vertical section of the head through the parietal tubera is shown. It will be seen that the section forms a much more tapering wedge when it enters the brim by the base first than when it enters it with the summit first. Now the transverse diameter of the base, or bi-mastoid diameter, is practically incompressible, measuring on the average about 3 inches. The bi-parietal diameter exceeds this by $\frac{3}{4}$ inch, measuring about $3\frac{3}{4}$ inches on an average. But the bi-parietal diameter can be reduced by moulding under pressure to the dimensions of the bi-mastoid without necessarily causing the death of the child.

Suppose that a forecoming head is engaging in a brim only very slightly too small to receive the bi-parietal diameter (*a*, *a*, Fig. 182), so that the points of contact with the brim are very close to the points, *a*, *a*. Even the forecoming head in this case forms practically a sufficiently tapering wedge,* and the reduction by pressure of the bi-parietal diameter is satisfactorily effected.

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* The head is equivalent to the wedge which would be formed by drawing tangents to the section at the points of contact with the brim. The mechanism is the same as that of the ordinary wedge as a mechanical power, except that the effect is expended in compressing the wedge, not in separating the surfaces between which it is driven

Suppose, on the other hand, that the bi-parietal diameter considerably exceeds the corresponding diameter of the brim, so that the points of contact are at some distance from *a*, *a* in the direction of *c*, *c* (Fig. 183). The equivalent wedge is then a very blunt one, the lateral compressing effect upon the head is therefore much diminished. At the same time the head is compressed vertically between the points of contact and the driving force acting on the base, *b*, *b* ; this vertical compression tends to bulge it out laterally near the parietal tubera, and counteract or overcome the other force of lateral compression. Fig. 183, is a diagram intended to represent the lateral bulging thus produced according to Sir James Simpson.

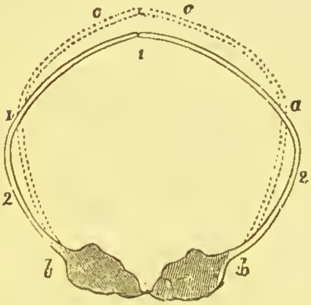

Fig. 183.—Transverse section of fœtal skull. The dotted line, *a a*, *b b*, *c c*, represents the normal outline. 1, 2 2, represents the alteration produced by the compression described.

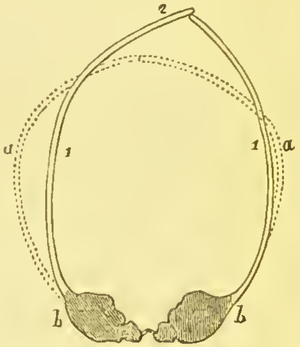

Fig. 184.—Transverse section of fœtal skull. *a a*, *b b*, normal outline. 1 1, 2, outline of skull as compressed by extraction after version.

Suppose, on the other hand, that the head enters the same brim base foremost. The wedge to which the head is equivalent is then more tapering, and the lateral compression therefore greater. Also, if traction is made on the body, there is substituted for the vertical compression caused by the driving force, a vertical tension, caused by the traction upon the base of the skull. The head is thus elongated in a vertical direction, and the effect of the pressure of the pelvic wall in reducing the lateral diameters is thus aided. (See Fig. 184.)

If, not the bi-parietal diameter, but some other transverse diameter of the head engaged in the conjugate meets with the

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since the former is yielding and the latter are not. The mechanical advantage increases the more tapering is the wedge. The compressing force is given by the formula $\frac{P}{2} \cdot \frac{\mu \sin. a + \cos. a}{\sin. a + \mu \cos. a}$ where P is the expulsive force, a the half angle of the wedge, and μ the coefficient of friction.

greatest resistance, the same general argument will apply, although in this case the original maximum transverse diameter of the section will not be quite so great in proportion to the diameter of the base.

Opposed to this advantage there is one disadvantage in the passage of the after-coming head. When it is the diameter engaged in the conjugate which meets with the greatest resistance, traction on the body generally tends to produce extension, because the condyles are generally posterior to this diameter, which is usually one only slightly behind the bi-temporal. (See Fig. 185.) The extension will go on until it has reached such a point that the line of traction passes through the diameter gripped in the conjugate. Hence not merely the fronto-occipital, but the occipito-mental, or maximum vertico-mental diameter of the head is liable to be thrown nearly across the transverse diameter of the pelvis. It will probably be unable to pass in this position, especially if there is general contraction, as well as flattening of the pelvis. Hence the extended position of the after-coming head is often a disadvantage in comparison with its position in extraction by forceps, not an advantage as is stated by some authorities.

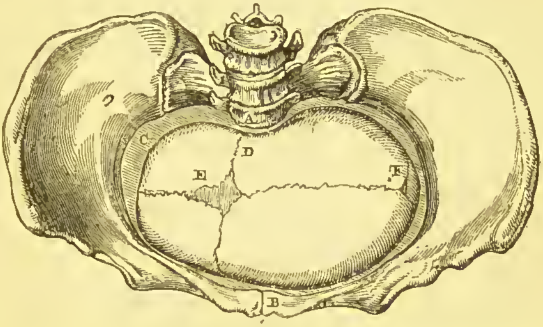

Fig. 185.—Passage of after-coming head through reniform flattened pelvis. A. Promontory of sacrum. B. Symphysis pubis. C. Space between forehead and ilium. D. Depression in fœtal head. E, F, Anterior and posterior fontanelles.

It is sometimes stated that a fœtal head can be brought through a pelvis having a conjugate diameter smaller by a quarter of an inch by means of version as compared with forceps. No such general statement, however, can be proved. Budin,* by experiments on an artificial pelvis, with a sacral promontory moveable to imitate different degrees of contraction, found that a premature fœtus could indeed be brought through by version with a less force than by forceps but that a full term fœtus could not. Much, how-

* La Tête du Fœtus au point de vue d'Obstétrique. Paris, 1876.

ever, depends upon the exact relation of the shape of the pelvis to that of the head. It is undoubted that, even at full term, sometimes a living fœtus, and still more frequently a dead one, may be extracted by version, when forceps of an efficient pattern have been tried, and have failed.

There is one condition in which version may have a special advantage as compared with extraction by forceps. This is when it can be made out that there is more room on one side of the pelvis than the other, especially when this is due to greater breadth of the wing of the sacrum, and greater depth of the depression at the side of the promontory on the corresponding side. Such a pelvis is shown in Fig. 185, p. 543. It will then be an advantage to have the broad bi-parietal diameter of the head on the widest side of the pelvis. Hence if the head should present by the vertex in such a way that the occiput is turned toward the wrong side, and the head is arrested at the brim, it is desirable to perform version so as to bring the occiput to the widest side of the pelvis. This may always be effected, if it is remembered that the leg which is brought down always eventually rotates anteriorly, under the pubic arch. Hence the rule is as follows:—If it is desired to bring the occiput into the right side of the pelvis, bring down the right leg, and conversely.

There is one condition, on the other hand, under which all authorities are agreed that forceps should have the preference over version. This is when the head is already engaged pretty deeply in the pelvis, though its maximum diameters may not yet have passed the brim. If, in addition, there is such retraction of the uterus, that the internal os (or the retraction ring, see p. 440), can be felt as a line of transverse depression, from the abdomen or as an internal ridge above the head on introducing the hand; if the uterus is so closely contracted round the fœtus, that the head cannot be elevated; or if the head has passed out of the cervix into the vagina, through the drawing up of the cervix; it should be inferred that the case is too far advanced for version, and craniotomy should be at once performed, if forceps fail. For, under these conditions, the attempt to perform version would risk the rupture of the uterus, and the interest of the mother forbids such a risk to be run for the possible chance of saving the child. For the same reason, if the mother's general state appears so critical that rapid delivery is urgently called for, it is generally better not to perform version. For, if craniotomy proves necessary after all, it is a more difficult and tedious operation on the after-coming head, especially if the disproportion is very great.

It is when the head is arrested above the brim, in a flattened pelvis, and the case not too far advanced, that authorities differ most as to the course to be pursued. The best plan appears to be that generally adopted in England, namely, to apply forceps, and try the effect of moderate traction, and then if this fails, to perform version, unless the alternative of symphysiotomy should be chosen by a skilled operator, and the patient and her husband give their consent to that operation. As to the comparative results of forceps or version as a first choice under these circumstances, very much depends upon the efficiency of the forceps used, something also upon the predilection of an individual operator for one operation or the other, and his consequent skill in the performance of it. Version is an operation performed in the interest of the child, and it should not therefore be chosen if the child is dead. If the fœtal heart has ceased to be heard, version should generally be rejected, if forceps have failed ; for, although the fœtus may be still just alive, it will hardly have vitality enough to survive the difficult passage of a contracted brim. If there is still greater certainty of the death of the child, no prolonged or very powerful effort should be made even with forceps, but early resort should be had to craniotomy.

The statistics of Guy's Hospital Charity afford evidence how much depends upon the use of an efficient instrument. Thus in the six years 1863—1869 delivery was effected by forceps or version in 20 cases of labour protracted in consequence of pelvic contraction, in which the head was arrested high above the brim. In 8 of these version was chosen as the primary operation, and the children were saved in 7 out of the 8. In 12 cases forceps were chosen for the primary operation. In 7 out of the 12 delivery was effected by their means, and 3 of the 7 children were living. In the remaining 5 delivery was effected by version after forceps had failed, and 3 of the 5 children were living. During these six years a pair of long curved forceps (Lever's) was in use, but these were rather short in the handles, and pliant in the blades.

At the end of the six years a new pair of forceps was procured, otherwise similar in shape, but having longer handles, and more unyielding in the blades. During the next six years delivery was effected by forceps or version in 18 similar cases, in all of which forceps were chosen for the primary operation. In 17 cases out of the 18 delivery was effected by them, and 15 of the children were living. In the remaining case version was successful after forceps had failed, but the child was stillborn. Version was performed in other instances after the failure of forceps, but had to be followed up by craniotomy. There have, however, been a few cases since the above date, in which a living child has been delivered by version after even the more efficient forceps had failed.

Thus in delivery by the more efficient forceps 88·1 per cent. of the children were saved, a better percentage* than the average percentage in low forceps cases in the same Charity; in delivery by version 71·4 per cent. Among the 24 mothers delivered by forceps, there were no deaths; among the 14 delivered by version, there were two deaths. The 38 cases above enumerated, together with 15 only of craniotomy, comprise all the cases of most considerable disproportion between the fœtus and the pelvis out of 23,591 deliveries. These statistics appear to show that the use of forceps in contracted pelves is not inferior in safety to version, and to be in strong contradiction to the opinion of many German and American authorities that this operation is very dangerous when the head is arrested high above the brim, and to the statement of Lusk,† that, when the head does not engage in the brim, it should be placed under the ban as hardly less dangerous than Cæsarian section was, before the modern improvements in that operation.

The same conclusion is confirmed by the last report of the Guy's Hospital Charity for the years 1875—1885. Forceps were used at the brim 92 times; 6 of the mothers died, and 18 of the children. Version was performed for various reasons when the head was at the brim in 33 cases, out of which 5 of the mothers and 29 of the children died. It must be stated, however, that, in 10 of the version cases, forceps had been previously tried in vain.

The following comparisons will further show the gain as regards fœtal mortality in contracted pelves from the modern improvement in midwifery practice. The improvement in question probably consists mainly in the employment of longer and more unyielding forceps than it was formerly thought safe to use, and in a less reluctance to employ them when the head is high in the pelvis. In the Guy's Hospital Charity, between 1833 and 1854, craniotomy cases were 3·6 per 1000; between 1854 and 1863 they were reduced to 1·2 per 1000; between 1863 and 1875 they were further reduced to 0·7 per 1000, or more than fivefold in about forty years. In the following ten years, 1875—1885, they remained about the same, namely, 0·9 per 1000, so that the minimum possible had probably already been attained in 1863—1875. Again, at the Rotunda Hospital at Dublin, between 1847 and 1854, when the straight forceps, to which the Dublin school was long attached, were still in use, craniotomy cases were 7·9 per 1000; between 1868 and 1875, after long curved forceps had been adopted, they were reduced to 3·5 per 1000.

It is probable that the introduction of axis-traction forceps (see

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* Out of the total number of forceps cases the percentage of children saved was 76·9.

† "The Science and Art of Midwifery," p. 475.

Chapter XXXIII.) enlarges still somewhat further the scope of extraction by forceps in contracted pelves, both in comparison with version and with craniotomy. But it, perhaps, can hardly be anticipated that material advance will be gained on the results of the Guy's Charity as quoted above, both as regards the extreme rarity of resort to craniotomy, and the successful results, both to mothers and children, of extraction by forceps in the considerable degrees of pelvic contraction. It should be mentioned that although forceps have been used very sparingly in the Guy's Charity (only once in 197 deliveries from 1863 to 1875; once in 93 deliveries from 1875 to 1885), it has been the practice not long to delay the operation when considerable pelvic contraction is recognised.

The average transverse diameter of the incompressible base of the skull is about 3 inches. Hence, allowing a little for the soft parts, it cannot be expected, as a rule, that a living child at full term will be delivered with a conjugate diameter much under 3¼ inches. In exceptional cases no doubt a full-term child is delivered with a conjugate of 2¾ inches by forceps, version, or sometimes even by the natural powers. Thus in a case in the Guy's Hospital Charity, where the patient was at term in her second pregnancy at the age of 24, craniotomy had to be performed, with the head arrested high above the brim, and the conjugate diameter was estimated at not more than 2¾ inches. But at her first confinement, she had been delivered spontaneously of a living child after 24 hours' labour.

Hence version should never be performed with a conjugate under 2¾ inches, nor with one under 3 inches if there is evidence that the head is large. No prolonged efforts to extract with forceps should be made with a conjugate less than 3¼ inches. With a conjugate under 2¾ inches, the choice will be between craniotomy and Cæsarian section. With a conjugate from 2¾ inches upward, there is the alternative of symphysiotomy, if the child cannot be extracted by forceps.

In the case of the generally contracted pelvis, extraction by forceps is always preferable to version. If forceps fail, recourse must be had to craniotomy or symphysiotomy, and not to version. The difficulty here does not lie mainly in the transverse diameters of the head. Hence there are neither the disadvantages in the use of forceps, nor the advantages in version, which exist in the flattened pelvis. Moreover, after version, the extended head would probably find insufficient room for its long diameter in any diameter of the pelvis. The generally contracted pelvis not unfrequently gives occasion for craniotomy, even when the conjugate diameter is as much as 3½ inches. In the generally contracted pelvis more advantage is gained by symphysiotomy than in the flattened pelvis, because in this case a great part of the difficulty lies in the transverse diameter, which is much more increased by symphysiotomy than the antero-posterior.

Extraction of the after-coming head.—In the extraction of the after-coming head more assistance to nature is generally required than in primary pelvic presentations, with a normal pelvis. Before the shoulders engage in the brim, it is well to pass the hand into the vagina, and make sure that the arms do not become extended in the brim, by the side of the head, drawing them down, if necessary, over the chest. When the head engages in the brim, extraction must be effected quickly if the child is to be saved. The legs may be grasped, wrapped in a napkin, and traction made nearly in the axis of the brim. At first, just as the head is entering the brim, the direction of traction should be a little more forward than this, in consequence of the "curve of the false promontory." In case of doubt, various directions of traction may be tried in a tentative way, but not to the extent of making a "pendulum movement," which might injure the neck, or rub the head backward and forward against the brim. Advantage may also be gained by having an assistant to press down the head from the abdomen.

If the head will not pass, it will generally be found, on passing up the hand to examine, that it is too much extended. There are two ways of overcoming this and promoting flexion. The first is to incline the direction of traction as much as possible toward the side of the pelvis to which the occiput is directed. If the line of traction can thus be made to pass between the forehead and the diameter most tightly gripped, descent of the forehead more than the occiput, and therefore flexion of the head, will be promoted. The pressure of the lateral pelvic wall against the occiput also forms, with the lateral component of the traction, a "couple," or pair of equal and opposite forces, which aids the same effect.

Jaw traction.—Another still more effective expedient, and one which may be combined with the former, is that of jaw traction, which often may turn the scale in favour of the child in a head-last case. It has the advantage that it not only promotes flexion, since the maxillary joint is generally slightly anterior to the diameter gripped in the conjugate, but increases the force of extraction, without increasing the dangerous tension applied to the neck. The index finger should be placed on the edge of the lower maxilla, and the jaw drawn downward at the same moment that traction is made upon the legs with the other hand. Care must be taken that the finger is not passed too far back, so as to injure the floor of the mouth or the larynx. Since a certain amount of injury may be done to the jaw, and the child's power of sucking thereby impaired, the expedient should not be used until simple traction has been tried and failed.

In laboratory experiments on the amount of traction which could be placed on the lower jaw without causing injury, Matthews Duncan* found that, in several instances, up to a weight of 56 lbs., no obvious injury was produced. In one case, a crack was heard at 28 lbs. It thus appears that, in many cases, an additional amount of force can thus be obtained without serious injury to the child, equal to more than one-half of that which can be safely applied through the neck (see note, p. 540). The additional amount of force thus obtained is generally of more importance than the flexion. It is not, indeed, an actual flexion which can be expected, but only a limitation of extension; for the traction by the spine will often have greater effect in causing extension than the jaw traction in causing flexion, if the diameter engaged in the conjugate is the one most tightly gripped. The jaw traction, however, will limit the amount of extension produced to that degree from which it results that, not the direction of the spinal traction, but that of the resultant of the spinal traction and jaw traction, passes through the diameter of the head most tightly gripped. The result will probably be to keep the head in moderate extension, so that only the fronto-occipital, and not a diameter nearly approaching to the mento-occipital, or maximum vertico-mental, is thrown across the transverse diameter of the pelvis. The inclination of the tractile force toward the side where the occiput lies, described on the preceding page, may materially aid in limiting extension. It is to be remembered also that, when the transverse diameter of the pelvis is large in proportion to the head, it may allow room for the long diameter of the head, even in the position of maximum extension likely to be attained, and then the additional traction force is alone of value.

The mode of extracting the head through the pelvis and vaginal outlet has already been described (pp. 254—255). If its passage is resisted by the pelvic outlet, as may be the case in the uniformly contracted pelvis, jaw traction may be used in the same way as at the brim. It will rarely be required to overcome the resistance of soft parts only.

Symphysiotomy.—The favourable results recently obtained in the revived operation of symphysiotomy render this operation an available alternative in the less extreme forms of pelvic contraction, whenever moderate traction with forceps fails to deliver the fœtus. The limits suitable for its adoption are from a conjugate of $2\frac{3}{4}$ inches upward. It has indeed been successfully performed with a conjugate as small as 2½ inches, but, when the contraction is so great as this, it is doubtful whether the risk is less than that of Cæsarian section, taking into account the fact that, in Cæsarian section, the patient may be sterilised, and saved from the danger of future pregnancies. The drawbacks to the operation are that it is a somewhat severe surgical operation for the patient to undergo, although one of low mortality in the hands of skilful operators, and not a very easy one for an inexperienced operator to perform. The clitoris must necessarily be divided from one pubic bone; and, if there is a wide separation of the bones, its vessels and nerves may also be divided or torn on one side. Some cicatricial tissue may therefore result in this situation. There is also the possible risk of some lameness in future, if the bones do not unite closely, but this can probably be obviated by wiring the bones. The operation may thus be offered to the patient and her husband as a means of saving the life of the child, and one which offers a much better prospect of doing so than version, forceps having failed. But they cannot be blamed, in the author's opinion, if they should decide in favour of the destruction of the child.

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* "On Traction by the Lower Jaw in Head-last Cases." Obstet. Trans., Vol. XX.

Choice between craniotomy and Cæsarian section.—In the more moderate degrees of contraction, craniotomy is an operation involving very little risk to the mother. If bad results follow, they are generally due rather to the previous prolongation of labour, or the efforts to extract a living child by forceps or version, than to the operation itself, provided that it has been performed skilfully. In the severer degrees of contraction, however, the case is different, especially when the disproportion is so great that there is much difficulty in extracting the body as well as the head of the fœtus through the brim. In these severer degrees of flattening, the pelvis is almost always rachitic, and generally contracted as well as flattened, so that the want of space in the transverse diameter seriously increases the difficulty of the operation. Under these circumstances it is one of considerable risk to the mother. According to Perry, craniotomy in America, in 70 cases of pelves having a conjugate measuring 2½ inches and under, gave a mortality of 38·5 per cent. Out of 25,689 deliveries in the last report of the Guy's Hospital Charity, there were 24 cases of craniotomy, with 4 deaths, or 16·6 per cent., including one case in which the uterus was ruptured before the craniotomy.

The recent improvements in Cæsarian section have greatly enlarged its field as compared with craniotomy. In the operations performed according to Sänger's method by the most skilful hands, as at Dresden and Leipsic, the mortality does not exceed 12 per cent. But in all operations reckoned as Sänger's operations, performed in all countries, the mortality, according to Dr. R. P. Harris's statistics, up to the end of 1889, was 23·5 per cent.

Some have claimed that craniotomy must now be regarded as a murderous operation because it destroys the child, and that Cæsarian section may displace it altogether, but this conclusion is not as yet justified. In general, in all cases where it is likely that, on a future occasion, a living child may be obtained by the induction of premature labour, craniotomy should be chosen in preference to Cæsarian section. For, in such cases, the operation does not involve much danger to the mother; and even fœtal life may be the gainer in the end, if she survives to bear other children.

The following may be taken as the present position of a controversy which is liable to be modified by improvements in operation. With a conjugate diameter of $2\frac{1}{2}$ inches or less, Cæsarian section is preferable if it can be performed as a first choice, early in labour, and by an operator experienced in abdominal surgery. If, however, attempts have been made to extract through the pelvis, or the patient is exhausted with protracted labour, craniotomy is preferable down to a conjugate of $2\frac{1}{4}$ or even 2 inches, if there is a fair transverse diameter and room at the sides of the sacral promontory. A skilful operator is justified in choosing Cæsarian section, with a conjugate up to $2\frac{3}{4}$ inches, or if a patient has lost several children in labour, notwithstanding induction at the seventh month, through difficulty in extraction; providing that she is willing to run the risk for the sake of a living child. With a conjugate of $2\frac{3}{4}$ inches and upward, symphysiotomy appears to involve less risk to the mother, and it is available when labour is already somewhat prolonged.

The method of extraction after craniotomy will be described in Chapter XXXIV.; the choice between Sänger's Cæsarian section and Porro's operation, in Chapter XXXV.

Induction of premature labour.—By the induction of premature labour, two advantages are obtained: first, the smaller size of the head; and secondly, the more yielding consistency of the bones, allowing the diameter engaged in the conjugate to undergo a greater reduction from pressure. Benefit is thus gained both for the mother and the child. Labour is less severe for the mother, and there is a greater chance of a living child being born in those cases in which such a result is not probable at the full term.

In the slighter degrees of contraction, in which there is a fair prospect of a living child being born alive at full term, either spontaneously or with the aid of forceps or version, it is better not to induce labour, for the amount of interference necessary for the induction of labour does somewhat increase the risk to the mother, although not to such a great degree as a severe instrumental delivery would do. In the flattened pelvis, the scope of the operation lies chiefly among conjugate diameters varying from $3\frac{1}{2}$ down to $2\frac{3}{4}$ inches. In the generally contracted pelvis, it may be called for even with a conjugate above $3\frac{1}{2}$ inches. Since, however, the average size of the child varies in different women, and the transverse measurements of the pelvis cannot be exactly estimated, the history of previous labours, when the patient is not a primipara, gives even more information than the measurement of the pelvis. As a general rule, when craniotomy has been required in a former labour on account of disproportion between the fœtus and the pelvis, or when the child has been stillborn, in consequence of delay within the pelvis, even though delivered whole by forceps or version, premature labour should be induced in subsequent pregnancies. A primipara, with a conjugate of $3\frac{1}{2}$ inches or more, may be allowed to go to full term. If the patient is a multipara, most reliance should be placed upon the history of the more recent labours, since, in contracted pelvis, the difficulty is apt to increase progressively with increased size of the children. If a female child only has been with difficulty extracted alive at term, it may sometimes be desirable to induce premature labour on a subsequent occasion, since the difficulty is likely to be greater if the next child proves to be a male.

Some German authorities, as Litzmann and Spiegelberg, have argued against the expediency of the induction of premature labour on the ground of statistics apparently showing the mortality to children, as well as to mothers, to be greater in cases of premature labour than in those of labour at the full term in contracted pelves. These statistics are fallacious, because they include in the latter class the commoner and slighter degrees of pelvic contraction, in which it is admitted that the induction of labour is unnecessary and inexpedient. When different labours are compared in the same woman, in whom pelvic contraction is considerable, the advantages of the induction of labour are strikingly exhibited. Thus Milne* records 38 induced premature labours in 6 women without any maternal death, in which 35 children were born alive. In 12 labours at term of the same 6 women, only 1 child was born alive.

With a conjugate less than $2\frac{3}{4}$ inches there is practically little chance of a living child being secured even by induction of labour. There is, however, just a possibility of it with a conjugate a little under $2\frac{3}{4}$ inches, provided the transverse diameter is large in proportion, and the pelvis is reniform, with ample space at the sides of the sacrum. Under these circumstances a trial of the effect of induction may be made. When the contraction is so great that a living child cannot be hoped for, that is to say, in most pelves with a conjugate less than $2\frac{3}{4}$ inches, it is better to let the patient go to full term. The extra disturbance and risk involved in the induction of labour are thereby avoided. In extreme forms of contraction, as with a conjugate of $2\frac{1}{2}$ inches or less, Cæsarian section will now generally be chosen, if there is an opportunity of arranging for its performance by an operator skilled in abdominal surgery.

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* "Premature Labour and Version," Edin. Med. Journ., Vol. XIX.

Date for induction of labour.—Although a child is nominally regarded as viable at the end of six months, there is so little chance of its surviving if born before about the end of the seventh month, that it is not worth while to induce labour before that time for the sake of the child. In choosing the exact time in any given case, regard should be paid, not only to the size of the conjugate diameter, but to the other dimensions and shape of the pelvis, to the amount of difficulty found in extraction at term, and still more to the results of induction on any former occasion. Thus, if labour has been induced before, say at the eighth month, and the child has been lost through delay at the brim, it should be induced earlier on the next occasion. If it has been induced, say at the seventh month, and the child has passed very easily, the patient may be allowed another time to go a little longer, especially if the former child did not prove strong enough permanently to survive.

So far as the conjugate diameter can be taken as an indication, the following may be given as reasonable rules :—

With a conjugate of $3\frac{1}{2}$ inches induce labour at the end of the 36th week.
" " $3\frac{1}{4}$ " " " 34th "
" " 3 " " " 32nd "
" " $2\frac{3}{4}$ " " " 31st "
" " $2\frac{5}{8}$ " " " 30th "

Induction of abortion.—When contraction is so great that there is no hope of obtaining a viable child, and extraction by craniotomy at full term is likely to be very difficult and dangerous, it is better to induce abortion at the earliest opportunity, especially before the tenth week, unless the patient elects to go to full term, with the view of Cæsarian section being performed then. In the middle months of pregnancy there is greater likelihood of difficulty arising from the close attachment of the placenta to the uterus. It is better, however, to let the patient go to full term, if it is probable that extraction after embryotomy can then be carried out without great difficulty, for, after artificial abortion, pregnancy may recur quickly, and the frequent repetition of the operation is likely to lead to uterine disorder.

The methods of induction of premature labour and abortion will be described in Chapter XXXI.

Treatment of shoulder and transverse presentations in contracted pelvis.—In a flattened pelvis, as a rule, no attempt should be made to effect cephalic version, for delivery of the after-coming head will probably be more easily effected ; and, if the head were brought to present, podalic version might be called for afterwards. If, however, the contraction is so great that there is no chance of saving the child, then the head should be brought to present if possible, since, in considerable contraction, craniotomy with an after-coming head is a more difficult and tedious operation. In the pelvis æquabiliter justo minor also the head should always be brought to present if possible.

CHAPTER XXX.

RARE FORMS OF PELVIC DEFORMITY.

The Triradiate or Rostrated (Beaked) Pelvis.

This form of pelvis is evidently due to the pushing inward both of the sacrum with the lumbar spine and the acetabula toward the centre of the brim (see Fig. 186). The bending takes place earliest and most at the weakest part of the superior rami of the pubes as well as near the junction of pubes and ischium, and it is in this way that the characteristic beaked shape is produced (see Fig. 188, p. 557). The shape of the brim comes to resemble a three-rayed star, regular or irregular, the anterior ray being generally the narrowest.

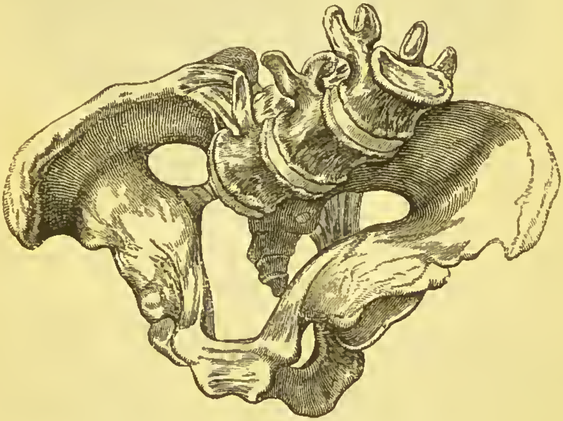

Fig. 186.—Triradiate malacosteon pelvis in extreme deformity, viewed in the axis of the brim.

Causation.—The triradiate pelvis is most frequently the result of osteo-malacia, or mollities ossium. This is a disease extremely rare in Britain, and still more so in America, where insufficient feeding is less common. It appears to be endemic in certain districts, especially in Italy and near the Rhine. The main cause seems to be something unsuitable in food and sanitary conditions, with probably the addition of some influence of climate and locality. Osteo-malacia, like rickets, softens the bones, but it differs from rickets in that, almost invariably, it softens them after they have attained maturity, softens them throughout instead of only at the growing portions, and softens them to a much higher degree.

Osteo-malacia is almost confined to the female sex, and is especially associated with pregnancy. This may be explained, in some degree, by the expenditure of lime-salts for the nutriment of the fœtus. It rarely occurs in a first pregnancy, more frequently after repeated childbirth, and is generally recurrent in repeated pregnancies. Usually it is progressive, but sometimes it is arrested and the bones become hardened again in their abnormal state. The disease is a form of osteo-myelitis. The periosteum is generally thickened, soft hypertrophic medullary tissue, containing a large proportion of fat, is deposited in the bones, and the calcareous salts are absorbed. They are believed to be excreted through the kidneys. The result is that the bones become very light, pliant, soft, and friable, capable of being easily cut or indented. In some forms of the disease numerous spontaneous fractures take place. The disease sometimes affects the whole skeleton, but it may expend itself chiefly upon certain bones. In pregnant women, the spine and pelvis are generally most affected.

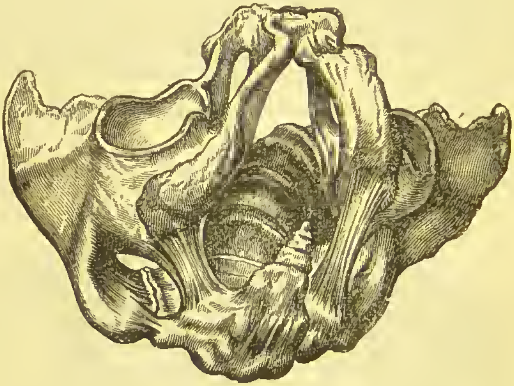

Fig. 187.—The same malacosteon pelvis seen from the outlet.

Mechanism of production of the deformity.—The reason why so different a state is produced from that of the usual rachitic pelvis is, first, that the bones are softened more uniformly, and more completely, so that they can no longer act as rigid beams or levers; secondly, that the woman is generally standing and walking, at least in the early stage of the disease, not constantly sitting, as in the rickets of young children. In the early stage the centre of the sacrum sinks somewhat into the brim, and the acetabula are driven inward by the inward pressure of the heads of the femora, including the effects of muscular force and that of pressure in lying on the side (see p. 23). The bending takes place most at the thinnest parts of the bones in the anterior half of the pelvic ring, that is in the superior rami of the pubes, and near the junction of pubes and ischium (see Figs. 187, 188). Thus, the acetabula come to look more forward than usual (Fig. 189, p. 558), the pelvis becomes beaked, and the shape of the brim, in the earlier stages, is a pointed heart-shape (Fig. 188), transverse contraction predominating. The tubera ischii are carried inward with the acetabula, so contracting the outlet (Fig. 189, p. 558).

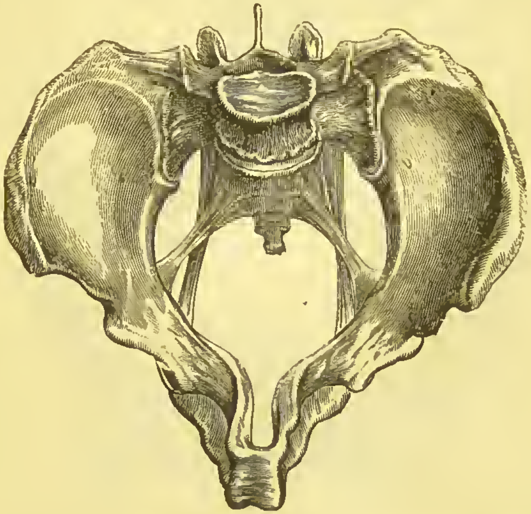

Fig. 188.—Rostrated malacosteon pelvis, in earlier stage of deformity.

The effect of the approximation of the acetabula is that the outward leverage upon them, due to the reaction of the body-weight in standing and walking, is diminished, and eventually converted into an inward leverage, if the acetabula are brought nearer to the middle line than the sacro-iliac joints (see p. 508). The same reaction to the body-weight, on account of the forward direction of the acetabula, comes to have a component acting inward perpendicular to the pelvic wall, tending more and more to bend the ilia, as distortion progresses. The reaction to the body-weight in sitting, acting on the tubera ischii, also comes to exercise an inward instead of an outward leverage, as soon as the tubera are nearer to the middle line than the sacro-iliac joints (see p. 509). Hence all the forces causing distortion act at constantly increasing advantage as distortion progresses. Eventually sacrum and acetabula approach nearer and nearer to the centre of the pelvis, as do the tubera ischii, and the space both of inlet and outlet is almost obliterated. The sides of the pubic arch are closely approximated. The crests of the ilia are folded together and the Dist. Sp. Il. diminished. The acetabula, and with them the ilio-pectineal eminences, are also forced upward by the reaction to the body-weight, so that the anterior and posterior halves of the pelvic ring are no longer in the same plane. The inclination of the pelvis as a whole is also diminished, in consequence of the displacement forward of the sacrum into the brim, for the same reason as in the rachitic pelvis (see p. 524). In extreme forms of distortion, the spine often yields irregularly, producing corresponding irregularity in the pelvis (Figs. 186, 187).

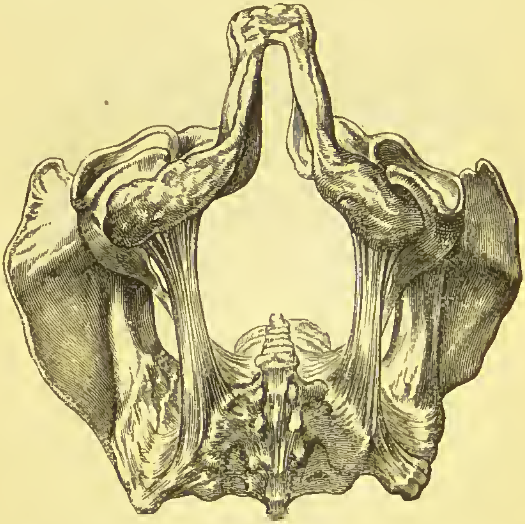

Fig. 189.—Rostrated malacosteon pelvis, seen from the outlet.

The contrasts between the flattened rachitic and the malacosteon pelvis are shown in the following figures after Matthews Duncan, following Meyer,* and Tyler Smith. Figs. 190, 191, 192 are profile sections of that part of the true pelvis which is above the middle of the third piece of the sacrum. The pelvic brim is considered as divisible into two parts, one posterior and another anterior, separated from each other by a line drawn across the pelvis from one ilio-pectineal eminence to another.

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* Ed. Med. Journ., April, 1856.

N, Fig. 190, is a section of the normal pelvis; R, Fig. 191, of the rachitic pelvis; M, Fig. 192, of the malacosteon pelvis. The other letters are the same in each figure. K is a line drawn from the promontory of the sacrum, P, to the middle of the third piece of the sacrum, W. C is the antero-posterior diameter of the brim; S, the top of the symphysis pubis; D, a diagonal diameter joining S and W. T is the point where the horizontal line joining the ileo-pectineal eminences cuts the plane of section. The dotted lines T S, T P

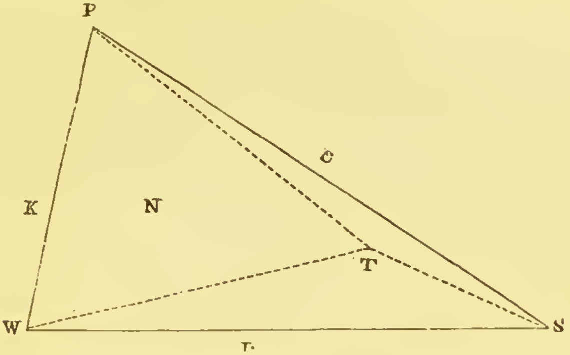

Fig. 190.—Profile section of normal pelvis. (After Matthews Duncan.)

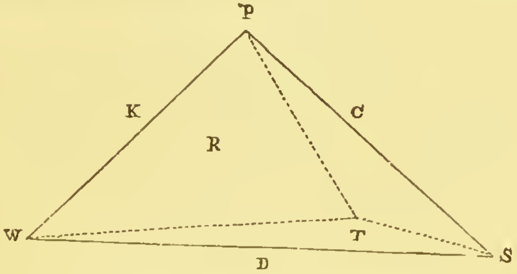

Fig. 191.—Profile section of rachitic pelvis.

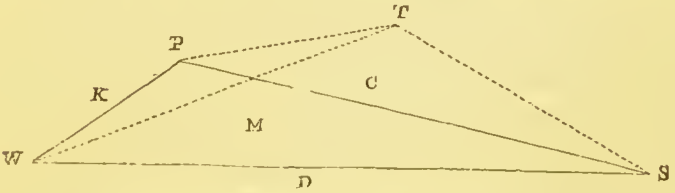

Fig. 192.—Profile section of malacosteon pelvis.

therefore show the relation of the anterior and posterior halves of the pelvic ring to each other, and it will be seen that in the normal pelvis (Fig. 190) they are almost in the same plane.

The relative position of T in the two other figures shows the relatively small influence standing and walking have in the flattened rachitic pelvis, and their large influence in the malacosteon pelvis. In the malacosteon pelvis the acetabula are displaced upwards, carrying the ilio-pectineal eminences with them, and T lies above the line P S. The two halves of the pelvis, therefore, form an angle looking downward. In the rachitic pelvis, in which the reactions to the body-weight are chiefly through the tubera ischii in sitting, T lies lower than in the normal pelvis, and the two halves of the pelvis form an angle looking upward.

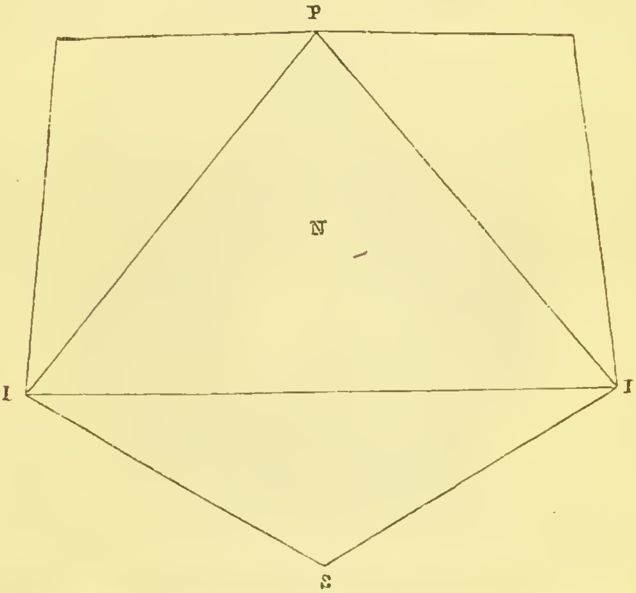

Fig. 193.—Transverse section of normal pelvis. (After Matthews Duncan.)

Again, in the rachitic pelvis (Fig. 191), the promontory of the sacrum, P, has descended, but has described nearly an arc of a circle, having the middle of the third piece of the sacrum at its centre, the sacrum not being compressible in the direction of its axis. In the malacosteon pelvis, on the contrary (Fig. 192), the sacrum is much shortened by compression in the direction of its axis, and the promontory, P, has in consequence descended almost vertically.

In Figs. 193, 194, 195, transverse sections of the three forms of pelvis are shown. P is the sacral promontory, S the top of the symphysis pubis, I, I the projections of the ilio-pectineal eminences upon the plane of section. The figures show the approximation of P to S in the rachitic pelvis, while the line I I is almost unaltered, the great approximation in the malacosteon pelvis of P, I, I, the three points upon which pressure is made, towards each other and towards the centre of the triangle P, I, I, and the rostrated form of the anterior half of the malacosteon pelvis.

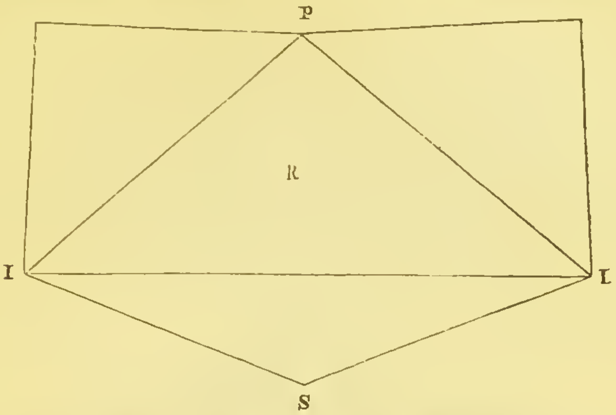

Fig. 194.—Transverse section of rachitic pelvis.

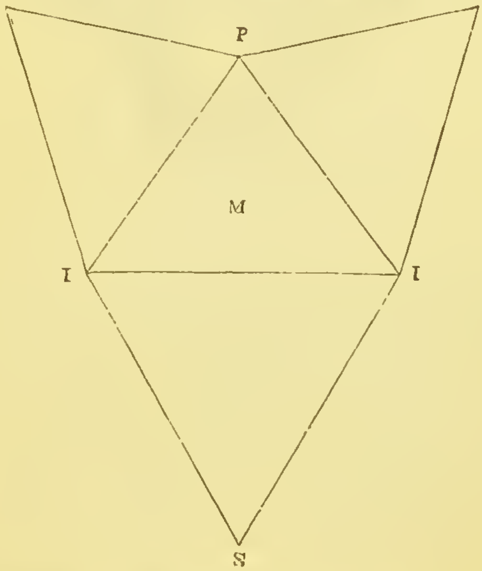

Fig. 195.—Transverse section of malacosteon pelvis.

The triradiate rachitic or pseudo-malacosteon pelvis.—In exceptional cases of rickets a form of pelvis is produced closely resembling the malacosteon pelvis (Fig. 196). For its production it is necessary that the softening of the bones should be greater and more general than usual, and that the disease should be prolonged beyond infancy, so that the child walks and stands while suffering from it. If the child walks and stands while the softening is only slight, the result is the rachitic generally contracted pelvis (see p. 519). The distinction from the malacosteon pelvis is made by the history, by the signs of rickets in other parts, by the small size of the pelvis, especially of the iliac fossæ, and by the fact that the normal relation between Dist. Sp. Il. and Dist. Cr. Il. is reversed, whereas in the malacosteon pelvis the spines are approximated. In other words, in the rachitic form the iliac fossæ are flattened and look forward, in the malacosteon they are folded together (Fig. 188, p. 557). In the rachitic form also the bones are not so pliable, and there is not the irregularity often seen in extreme degrees of osteo-malacia.

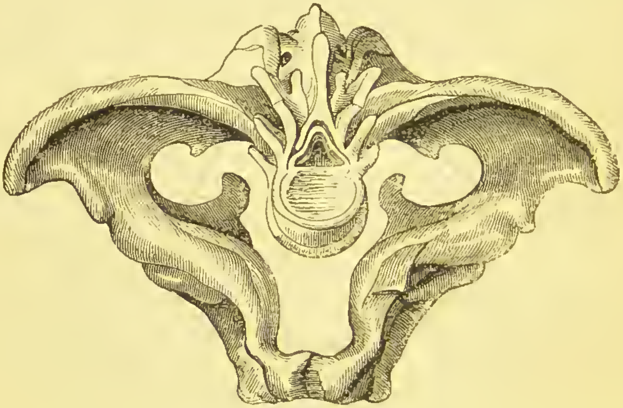

Fig. 196.—Pseudo-malacosteon rachitic pelvis, viewed in the axis of the brim. (Naegele.)

Diagnosis.—In the early stages of osteo-malacia, attention may be attracted to the disease by the occurrence of pains in the pelvis and other bones. When the deformity is established, diagnosis is easily made, in the slighter forms from the beaked shape of the pubes and narrowing of the pubic arch, in severe form from the great narrowing of the outlet and cavity of the pelvis in addition. The bones may be pliant under pressure, and there may be deformities also of the spine and other bones. The rachitic form is diagnosed by the characters given above, and by the bones being hard and not pliant.

Treatment.—In the malacosteon pelvis trial should always be made whether the bones may not prove to be pliable enough to allow the pelvis to be expanded by the hand passed into the vagina, sufficiently to allow extraction of the fœtus. Failing this, the choice will generally be between embryotomy and Cæsarian section (see Chapter XXXV.), although in minor degrees of deformity it may be possible to extract by forceps. It is especially when the outlet is so contracted that it is impossible to pass in the hand, or gain sufficient access for instruments, that delivery through the natural passages is likely to be impossible.

In the pseudo-malacosteon rachitic pelvis, with an equivalent degree of deformity, it is still more likely to prove impossible to extract through the pelvis, since the pelvis is originally smaller, and the bones are hard and not pliant.

THE OBLIQUE PELVIS.

There are three chief forms of oblique pelvis :—the scoliotic oblique pelvis, due to lateral curvature of the spine ; the oblique pelvis due to shortness or disuse of one leg ; and the oblique pelvis of Naegele, due to anchylosis of one sacro-iliac synchondrosis, and deficiency of the corresponding wing of the sacrum. There is a similar action of certain forces in the production of all these.

The scoliotic oblique pelvis.—In lateral curvature (scoliosis) of the spine, the bodies of the vertebræ are rotated to one side in the dorsal region, to the opposite side in the lumbar region. Generally the deviation is to the right in the dorsal region, being due to the over use of the right arm, and to the left in the lumbar region. The result is that the line by which the body-weight is transmitted to the pelvis is displaced to the same side as the bodies of the vertebræ, and one leg or tuber ischii has to bear more than its share of the weight. The bones and muscles of the overweighted leg often become thicker. Hence the inward thrust at the acetabulum, due to muscular action, is greater than on the other side, and this is one cause why the acetabulum is pushed inward, and the symphysis pubis is displaced toward the opposite side (Fig. 197, p. 564).

Another cause is the following. When the line of body-weight is displaced much to one side, it cuts the posterior sacro-iliac ligament on one side (see Fig. 13, p. 12) instead of falling in the middle line between the two ligaments. A consideration of the equilibrium of the sacral beam itself shows that the result must be that more and more strain is thrown upon those fibres of the ligament close to the joint, and upon the "bite" on the bony surface which exists in the joint itself, and is pressed more strongly than usual against the ilium. Otherwise, the over-weighted end of the sacrum would be displaced downward, away from the corresponding ilium. It follows that, although the weight transmitted to the ilium on the over-weighted side is increased, the posterior arm of the lever formed by the innominate bone is diminished in more than the same proportion. The leverage, therefore, is diminished on the over-weighted side, and that on the other side preponderates over it, and displaces the symphysis pubis toward the under-weighted side.

As soon as displacement of the acetabulum inward has begun, the principle already mentioned, by which the tendency to displacement is thereby increased, comes into play (see p. 509), for the outward leverage of the reaction to body-weight at the acetabulum is diminished, and may be eventually converted into inward leverage, as in the triradiate pelvis, if one acetabulum is brought nearer than the corresponding sacro-iliac joint to the middle line.

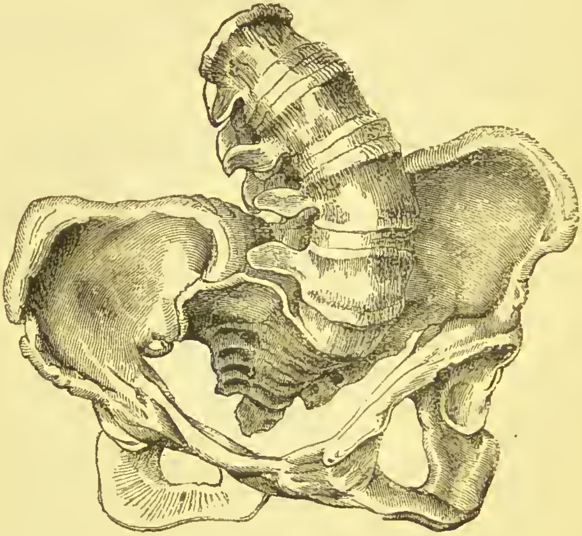

Fig. 197.—Scoliotic flattened pelvis. (After A. Martin.)

The other chief changes produced in consequence of the obliquity are the following. The wing of the sacrum and the ilium on the over-weighted side are thickened and shortened from the effect of extra pressure acting in the axis of the bone. The pelvic brim is elevated on the over-weighted side, there is some bulging inward opposite the acetabulum, the crest of the ilium is higher, the iliac fossa looks more inward.

Generally there is in addition some flattening in the scoliotic pelvis. This may be due simply to increased pelvic inclination in consequence of the normal antero-posterior curves of the spine being exaggerated, or it may be the result of associated rickets. The characters of the flattened pelvis, rachitic or otherwise, are therefore generally more or less combined with those mentioned above (see Fig. 197, p. 566).

The oblique pelvis from shortening or disease of one leg.—This is closely allied to the last form. Unless the legs are equalised by wearing a high boot, the pelvis is tilted downward on the side of the shortening. This displaces the line of the body-weight toward that side, and the shortened leg becomes over-weighted. Obliquity of the pelvis is produced by the same forces as in the former case. There is here also an additional cause, namely, that from the tilting of the pelvis the reaction to the body-weight at the acetabulum on the side of the shortened leg is inclined inward toward the centre of the pelvis (which normally it is not), and therefore has a component producing an inward thrust. The scoliosis of the spine, secondary to the tilting of the pelvis, will still further increase the effect.

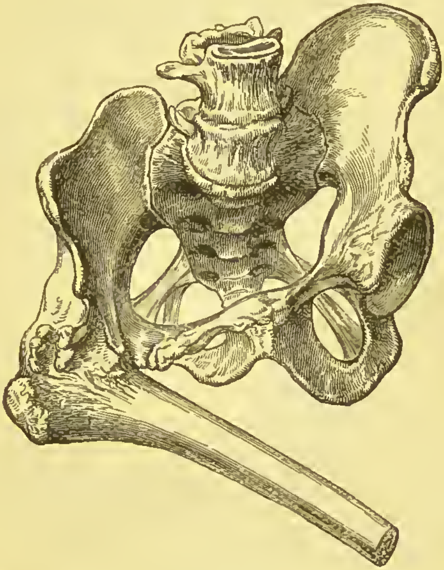

Fig. 198.—Oblique pelvis, from anchylosis of the hip-joint, and disuse of right leg.

A similar effect is produced when the function of one leg is destroyed, as by amputation, disease of hip-joint or other parts, fracture, or unreduced dislocation, and the patient stands and walks with the remaining leg and a crutch. The effects of overweight are then manifested on the side of the sound leg and the symphysis pubis is displaced toward the opposite side. In Fig. 198, p. 565, is shown an oblique pelvis due to the disease and anchylosis of one hip-joint. The atrophy of the pelvic bones, pubes and ischium, on the side which bears no weight, is in this case very marked.

The oblique pelvis of Naegele.—The essential characters of this pelvis are that there is complete anchylosis of one sacro-iliac joint, causing bony union between the sacrum and innominate bone, and an absence or imperfect development of that wing of the sacrum which is anchylosed. It may be due to disease of the joint in early infancy, or to caries affecting its neighbourhood. Naegele, however, himself considered that the deformity is the result of an original anomaly of development, because there is generally no history of disease, nor evidence of it in the appearance of the bones, and because the bony fusion is complete. In the case of anchylosis of the joint produced by inflammation later in childhood, a less complete form of the Naegele obliquity may result * (Fig. 200, p. 568).

Causation.—The deformity is produced in the following way. Complete bony union having been formed between the sacrum and the ilium at a very early period, the wing of the sacrum is unable to grow with the rest of the pelvis, and remains undeveloped. The growth of the ilium is not affected in the same way because the synostosis does not affect its growing extremities. The leverage of the innominate bone on the affected side is entirely destroyed, and the weight of the body on that side is transmitted through the bony union. Hence, since the ilium is not subjected to the usual bending force, its inner border on the affected side, which forms a part of the ilio-pectineal line, remains almost absolutely straight (see Fig. 199), instead of becoming more sharply curved than usual, as in the other forms of oblique pelvis (Fig. 197, p. 564, and Fig. 198, p. 565). This peculiarity is perhaps the most striking proof of the truth of the theory as to the leverage action of the innominate bone. The obliquity of the pelvis results from two causes : first, the deficiency of the sacral wing ; secondly, the anchylosis. This first calls out forces similar to those which act in the two other forms of oblique pelvis. The line of body-weight falls nearer to the acetabulum and tuber ischii on the affected side. Hence the leg on that side is over-weighted, the muscles hypertrophied in comparison with those on the other side, and the inward pressure at the acetabulum, due to muscular action, is increased. At the same time, the outward leverage † at the acetabulum, due to the reaction to the body-weight, is diminished, because the direction of this reaction, projected on a plane parallel to the brim, does not fall so much outside the sacro-iliac synchondrosis as usual.

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* See Champneys "On the obliquely contracted pelvis of a child with left sacro-iliac synostosis," Obstet. Trans., Vol. XXIV.

† It is to be remembered that the *pressure* of the reaction to the body-weight is

In consequence of the anchylosis, the leverage exerted by the posterior sacro-iliac ligaments on the innominate bone on the sound side (see Fig. 18, p. 23) being unopposed, draws over the symphysis pubis toward the sound side, and thus forms an additional force causing obliquity. It is difficult to say which of the two causes has the greatest influence in causing the oblique shape. Probably the deficiency of the sacral wing has most, since an obliquity as great as that of the Naegele pelvis may result without any unilateral action of the leverage of the posterior sacro-iliac ligaments (see Fig. 198, p. 565). But the effect of the unilateral leverage is shown in the straightness of the ilio-pectineal line near the anchylosed joint, as already mentioned.

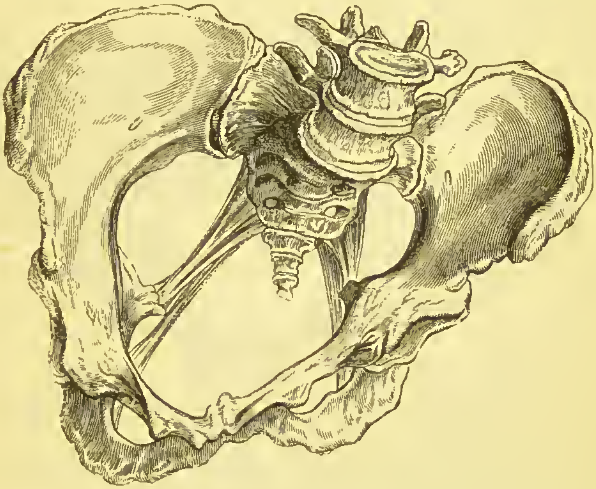

Fig. 199.—Oblique pelvis of Naegele.

The more obliquity has been already produced by the action of these two causes, the more the forces tend to increase the obliquity, according to the principle which has been already explained (see pp. 508, 509). For the outward leverage due to the reaction to the body-weight at the acetabulum may be eventually converted into an inward leverage, if the acetabulum has been brought nearer to the middle line than the sacro-iliac joint.

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directed neither outward nor inward, but vertically upward. It has, however, the effect of an outward leverage upon the acetabulum, because it acts upon the innominate bone as upon a lever hinged at the sacro-iliac synchondrosis (see pp. 21, 22).

Other resulting changes in the pelvis are that the affected side is elevated, the ilium is shortened and thickened from excessive pressure in the axis of the bone, the crest is elevated, and the iliac fossa looks more inward. The last peculiarity is more marked, being partly due to failure of leverage acting on the ilium. Owing to the synostosis on one side, that sinking forward of the sacrum between the ilia, which normally takes place in the advance from infancy to adult life, can only occur on the sound side. Thus is produced a turning of the anterior face of the sacrum toward the affected side, not only in reference to the distorted pelvis, but in reference to the mesial plane of the body. The pubic arch is narrowed, from one tuber ischii being inverted, and faces somewhat toward the deformed side (see Fig. 199).

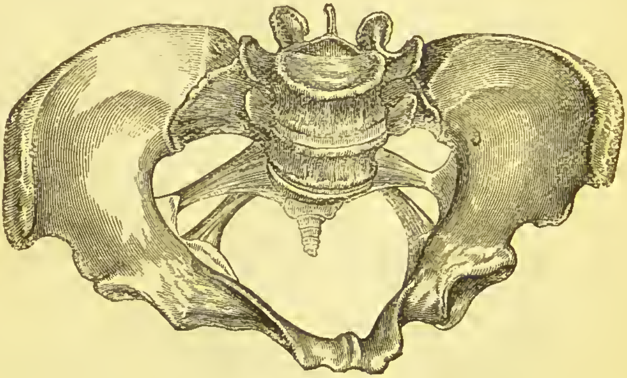

Fig. 200.—An oblique pelvis of Naegele, in which the distortion is only slight.

There is an important difference as regards the tuber ischii. In the scoliotic pelvis (see Fig. 197, p. 564) this is *everted* in the usual way from the reaction to the body-weight acting on the tuber ischii in sitting (see p. 25), especially since the pelvis generally partakes of the flattened character, and this side has to bear more than its share of the weight. In Naegele's oblique pelvis, on the contrary, owing to the absence of the sacral wing, and the straightness of the innominate bone, the tuber ischii initially falls very little outside the line joining the junctions of the innominate bone with the sacrum and pubes. The tendency to rotate the lower part of the innominate bone outwards on an axis passing through these junctions is therefore much diminished, and the tuber ischii, which is always drawn inward by the tension of the great sacro-sciatic ligament, remains *inverted*, as compared with that on the opposite side, and so contracts the pelvic outlet. The same counter-pressure on the tuber ischii, since the tuber is often nearer the middle line than the synostosis of sacrum and ilium, tends also to rotate the anterior end of the innominate bone inward on an axis perpendicular to the brim through that synostosis. The former of those two effects depends upon the component of the counter-pressure resolved perpendicularly to the plane of the brim, the latter upon the component resolved in a direction parallel to the same plane, as explained at pp. 25, 26. Thus the effect of sitting, as well as standing, tends to increase the obliquity.

In all the forms of oblique pelvis the ilio-pectineal line on the under-weighted or less contracted side has its curvature diminished at the posterior part, and increased at the anterior part. Not only is the ilium on the over-weighted side shortened and thickened by excessive pressure in its axis, but the same effect is produced also on the superior ramus of the pubes which forms the opposite quadrant of the pelvic brim, for, being parallel to the oblique diameter which is undergoing compression, this is also subject to extra pressure in its axis.

In all forms of oblique pelvis, one oblique diameter of the brim is shortened and the other, if anything, lengthened. Also the greatest shortening affects the sacro-cotyloid diameter on the over-weighted side. The shortening and the general contraction are much the greatest in Naegele's pelvis, on account of the absence of the sacral wings and the contraction of the outlet. A pelvis, approximating in shape to Naegele's pelvis, may be produced if, without any anchylosis, but in consequence of caries, disease of the joint, or any other cause, one wing of the sacrum is less developed than the other.

Diagnosis.—Scoliosis of the spine or an affection of one leg will attract attention to the probable pelvic obliquity. A Naegele's pelvis may easily be overlooked unless special examination is made. A difference in the distances from the last lumbar vertebra to the posterior superior iliac spine, and from the tip of the sacrum to the tuber ischii on the two sides, is the best sign of deficiency of one wing of the sacrum. If the woman is made to stand upright, and a plumb-line is let fall from a sacral spine, and another from the symphysis pubis, a line joining the two will deviate from the mesial plane in any oblique pelvis. The best test, however, is vaginal examination. If the promontory of the sacrum is reached, it will be found to deviate to one side, and the diminished lateral space on that side will be detected. Certain external oblique or diagonal measurements may be compared on the two sides, but too much reliance should not be placed upon this comparison. The following characters are given by Naegele for the Naegele pelvis :—

1. The distance from the tuber ischii of the deformed side to the posterior superior spine of the opposite ilium is shorter than its fellow.

2. The distance from the anterior superior spine of the deformed side to the opposite posterior superior spine is shorter than its fellow.

3. The distance from the spinous process of the last lumbar vertebræ to the anterior superior spinous process of the deformed side is shorter than its fellow.

4. The distance from the great trochanter on the deformed side to the opposite posterior superior spine is shorter than its fellow.

5. The distance from the symphysis pubis to the posterior superior spine on the deformed side is longer than its fellow.

In all these, except No. 3, that is to say, in all the diagonal measurements, it will be seen that the posterior extremity of that measurement which exceeds its fellow is on the side of the anchylosis.

Mechanism of labour.—The mode in which the head enters the brim varies according to the exact size and shape of the pelvis. If the deformity is slight, the long diameter of the head enters in the longer oblique diameter. If one sacro-cotyloid diameter is greatly contracted, the corner of the brim which it shuts off cannot be utilised by the head at all. The long diameter then enters in a diameter approximating to the shorter oblique (see Fig. 197, p. 564, and 199, p. 567), but having its anterior end nearer to the symphysis pubis.

Prognosis.—Naegele's oblique pelvis causes great difficulty in delivery. According to Litzmann's statistics, out of 28 mothers there were 22 deaths; and 31 children were stillborn out of 41 cases. The scoliotic pelvis when combined with the rachitic tppe, may also cause great difficulty. While Naegele's oblique pelvis is very rare, slight degrees of obliquity, in combination with flattening of the pelvis, are relatively common.

Treatment.—If the deformity is considerable, and the head does not enter the pelvis, extraction by forceps may be tried. If this fails, embryotomy will generally be necessary. It is not desirable, as a rule, to perform version, unless the flattening of the pelvis preponderates over its obliquity. But if the long diameter of the head does not appear to lie in the best available diameter of the pelvis, version may be performed, the leg brought down being so chosen as to bring the head into the opposite oblique diameter. But it must be remembered that, in considerable obliquity, the longer oblique diameter of the pelvis does not give most room for the head. If the head cannot be brought through, perforation of the after-coming head must be performed.

In the oblique pelvis of Naegele, the difficulty is likely to be greater, and embryotomy, or Cæsarian section, will often be requisite.

Ischiopubiotomy.—Prof. Pinard of Paris has successfully performed the new operation of ischiopubiotomy in an oblique pelvis of Naegele. The two rami of the pelvis are sawn through on the diseased side between pubes and ischium. The symphysis pubis is thus allowed to rotate outward upon the sacro-iliac joint of the sound side, as the two pubic bones do in symphysiotomy. The gap thus obtained is supposed to be better placed for allowing the head to pass than if it were at the symphysis pubis.

TRANSVERSELY CONTRACTED PELVIS.

There are two most marked forms of the transversely contracted pelvis, namely, the transversely contracted pelvis of Robert (Fig. 201, p. 572), due to ancbylosis of both sacro-iliac joints, and the kyphotic pelvis (Fig. 202, p. 573).

Transversely contracted pelvis of Robert.—The mode of formation of this deformity has to be considered in close connection with the obliquely contracted pelvis of Naegele. The difference is that, in Robert's pelvis, the anchylosis affects both sacro-iliac synchondroses, and consequently development of both wings of the sacrum fails. Hence there is no inequality from unilateral action, but the other effects of the failure of the action of leverage on the ilia, and the want of the transverse width given to the pelvis by the sacrum, are apparent. Not only does the widening of the pelvis usually caused by the leverage exercised by the posterior sacro-iliac ligaments fail, but the outward leverages at the acetabula, due to the reactions to the body-weight (see p. 508), are diminished, the acetabula being nearer to the middle than usual. On both sides the inner border of the ilium which forms part of the ilio-pectineal line is nearly straight, and thus the transverse narrowing, due to the want of the alæ of the sacrum, is increased. Both tubera ischii are inverted, instead of one, as in Naegele's oblique pelvis, and hence the outlet is contracted even more than the inlet (see p. 509), the pubic arch is very acute, and the pelvis somewhat funnel-shaped. The distance between the tuberi ischii may not be more than two inches. The antero-posterior diameter of the brim is about normal, the transverse much contracted. The iliac fossæ are more upright than usual, but flat and directed anteriorly. In described pelves of this kind, the sacrum has been deeply sunk between the ilia; and the concavity, in transverse section, of the anterior surface converted into a convexity. This does not seem explained by the mode of production of the deformity, but may have been due to a softening of the sacrum by the diseased condition of the bone which produced the double anchylosis, or else to an exaggerated pelvic inclination.

Robert's pelvis is extremely rare, and only about eight well-marked pelves of this kind have been described. The difficulty in delivery which it causes is, as might be expected, much greater than even in Naegele's oblique pelvis. Of the eight cases above mentioned, the women were delivered in six by Cæsarian section. In two they were delivered by craniotomy, but died after parturition in both cases.*

The diagnosis would be easily made by the great contraction of the outlet, and the smallness of the transverse diameters (Dist. Sp. Il. and Dist. Cr. Il.).

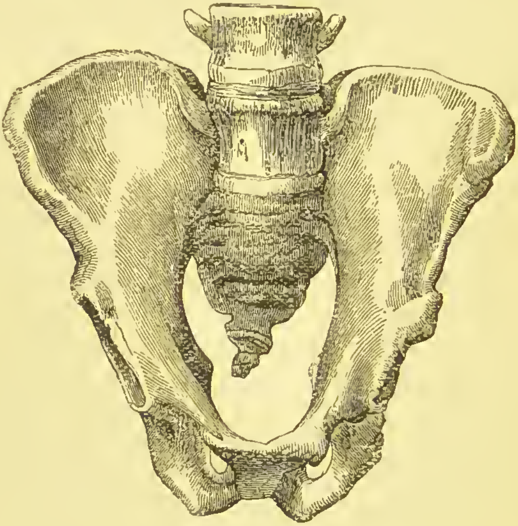

Fig. 201.—Transversely contracted pelvis of Robert.

I have met with one instance in which a similar transverse contraction of the pelvis was produced apparently not so much by absence of the wings of the sacrum as by extreme stunting in development of the whole bone, which was less than half its normal length as well as very narrow, while the antero-posterior diameter of the pelvis was normal. The transverse diameter of the outlet between the tubera ischii was less than two inches. The shortness of the sacrum, however, allowed more space than usual behind the tubera. Delivery was effected by the cephalotribe after craniotomy, without very great difficulty, entirely through the posterior half of the pelvic outlet, and the patient did well.

Treatment.—If the outlet allows sufficient space to apply the cephalotribe, the treatment adopted in the case last mentioned will be the best. The blades of the cephalotribe being kept exactly lateral, the head will be flattened in the direction best adapted for its passage. The alternative of Cæsarian section will arise in any case; and, if the outlet does not allow ready access of instruments, it should certainly be preferred.

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* Spiegelberg, Lehrbuch, 2nd ed., p. 244.

The kyphotic pelvis.—The kyphotic pelvis is a form of transversely contracted pelvis resulting from kyphosis (curvature with the concavity forward) of the lumbar vertebræ with the sacrum. (Fig. 202.) This is generally the consequence of caries in that situation leading to a falling together and fusing of the bodies of the vertebræ. Frequently, there is a compensatory lordosis (curvature with the convexity forward) in the dorsal region. When this is the case the natural curves of the dorsal and lumbar region are exactly reversed. If not, the plane of the pelvic brim is almost perpendicular to the general axis of the spine, as may be seen in Fig. 202. Hence, in order to preserve the balance of the body in standing or sitting, the pelvic brim must be almost horizontal instead of being inclined to the horizon at an angle 55° or 60°. Even when the kyphosis is somewhat compensated by a lordosis above, the pelvic inclination must be greatly diminished.

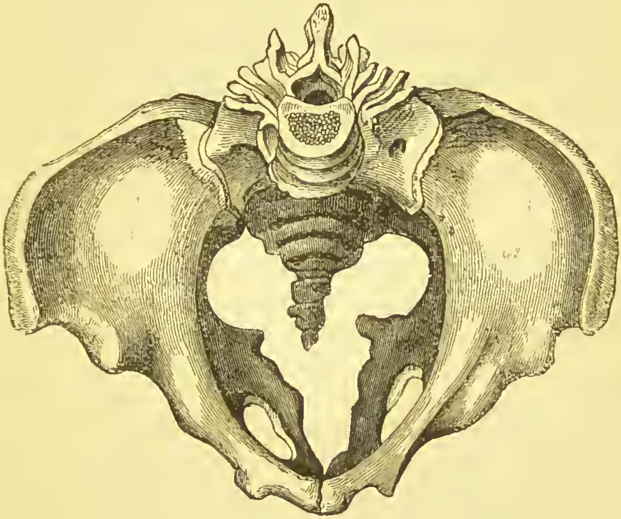

Fig. 202.—Kyphotic pelvis.

Mechanism of production of the deformity.—All the peculiarities of the kyphotic pelvis are explained by the abolition or diminution of the pelvic inclination. The weight of the body, instead of tending to force the sacrum downward into the brim, tends only to force it in the direction of the coccyx. Thus the action of the leverage of the innominate bone in widening the pelvis is almost or entirely abolished, and the inward thrust at the acetabula due to muscular action is unopposed. Thus the pelvis is flattened transversely and elongated antero-posteriorly, like a monkey's pelvis (see Fig. 10, p. 7). Narrowness already existing to some extent, the effect of sitting in everting the tubera ischii (see p. 509) is diminished or even reversed, while that of the tension of the great sacro-sciatic ligaments in inverting them is increased in consequence of the antero-posterior lengthening of the pelvis. The tubera and spines of the ischium are thus approximated and the pubic arch narrowed.

In standing, the weight of the body is transmitted to the pelvis much further back than usual in reference to the vertical plane through the heads of the femora. It can only be balanced on the heads of the femora by a general inclination of the spine forward, a position calling for more muscular effort to maintain than the normal position of the spine, namely, one coinciding on the whole with a vertical line, the curve falling alternately in front and behind. To avoid this muscular effort, in the position of "standing at ease," more strain than usual is thrown upon the ilio-femoral ligaments, attached to the anterior inferior spine of the ilium and the upper border of the acetabulum, and the spine is thus rendered more erect.*

The result of the over-action of the ligaments is shown by increased bony prominences in these situations (see Fig. 202). The effect of this increased tension tends to rotate the innominate bone on an axis passing through the sacro-iliac joint and symphysis pubis, inverting still more the lower part of the innominate bone, the tuber and spine of the ischium, and everting the upper part with the iliac fossæ. As regards the sacrum itself the results of the altered direction of the body-weight are that the transverse concavity is greater than in the normal adult pelvis, the antero-posterior concavity less. The promontory is not rotated forward, but rather the lower extremity, partly from the traction of the sacro-sciatic ligaments, partly from the falling together of the bodies of the vertebræ. The iliac fossæ are everted, looking upward and forward, and the S-shaped curve of the crest is slight. This result, like the inversion of the tuber and spine of the ischium, follows from the altered effect of sitting, and the traction of the ilio-femoral ligaments. In some cases the sacrum is very narrow, a result probably due to the disease which led to the kyphosis.

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* It is not sufficient merely to say that the rotation of the pelvis backward to bring about the diminished inclination, puts these ligaments on the stretch. If this were all, the ligaments would doubtless accommodate themselves to the position of the pelvis.

The final result is that at the brim there is alteration of shape but no contraction of importance, while at the outlet contraction may be very considerable. Unless the sacrum is narrowed, the brim is actually larger than normal, from the eversion of the upper part of the innominate bones.

Mechanism of labour.—It might be expected that the long diameter of the head would enter the long diameter of the brim, and it doubtless does so, when it fits the brim at all tightly, a result which can only happen when there is a considerable narrowing of sacrum or general contraction, in addition to the kyphosis. But it is most frequently found that the long diameter enters obliquely or even transversely, since it finds room to pass easily even the smaller transverse diameter, and its direction is therefore determined by that of the fœtus in utero (see p. 174). The difficulty generally begins when the head approaches the outlet. Here the head is often unable to use the anterior part of the space, on account of the approximation of the tubera ischii (see Fig. 202, p. 573). It frequently descends transversely, or with the occiput rotating somewhat backward, and passes through the outlet entirely behind the tubera ischii. This mode of delivery resembles that which is usual with the lower animals. The joints in this form of pelvis have not unfrequently been found somewhat yielding, and it is recorded that in some cases space between the tubera ischii has been gained by widening of the pubic arch. If the head passes the bony outlet in a transverse position or nearly so, the occiput may afterwards rotate forwards under the pressure of the soft parts. In some cases a compensatory lordosis, when situate very low down, has formed a projection overhanging the brim, and impeding the descent of the head into it.

Diagnosis.—The diagnosis will be made by the recognition of the spinal deformity, by the contraction of the outlet, especially the small distance between the tubera and spines of the ischium, found on vaginal examination, and by the difficulty of reaching the upper part of the sacrum.

Prognosis.—In the statistics collected by Champneys* of 32 labours occurring to 20 mothers, the results were that 9 mothers died, that is to say 45 per cent. of the mothers, or 28·1 per cent. of deaths in proportion to labours. 13 children died, or 40·6 per cent. These results doubtless give a higher mortality than the average, the gravest cases having been recorded. Not unfrequently labour is terminated naturally without great difficulty.

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* See Champneys, "The Obstetrics of the Kyphotic Pelvis." Obstet. Trans., Vol. XXV.

Treatment.—It will very rarely happen that interference is called for, in head presentations, until the head has descended far into the pelvis. If in any case assistance is required while the head is in the brim, or high in the cavity of the pelvis, the action of forceps is more favourable than in the flattened pelvis, since the compression of the head produced by them is exactly in that diameter of the pelvis where compression is wanted, namely in the transverse. Hence, in head presentations, version should never be performed. Forceps should be tried, if there appears to be a fair prospect of delivery by their means. If craniotomy is found necessary, extraction by the cephalotribe has an advantage similar to that of extraction by forceps. The blades of the cephalotribe being kept lateral, the compression exercised is precisely in the direction most required. The head flattened in the grasp of the instrument may pass in part between the tubera ischii, even when the distance between these is not above two inches. When the outlet does not afford a space measuring 2½ inches in its smallest diameter, and at least 3½ inches in a diameter bisecting the former at right angles, Cæsarian section will be justified, if it can be provided for beforehand. But it is probably always possible to deliver through the pelvis. Symphysiotomy will afford a greater relative increase of room than in a flattened pelvis. Induction of premature labour will be desirable in case of any considerable contraction of the outlet, if the patient comes under observation before full term, and the alternative of Cæsarian section is not preferred.

The spondylolisthetic* pelvis.—In the spondylolisthetic pelvis (Fig. 203, p. 577), the body of the last lumbar vertebra is dislocated forward upon the sacrum. The other lumbar vertebræ are carried forward with it, hanging over and projecting into the brim. The available conjugate diameter is thus greatly reduced, and is measured, not to the promontory of the sacrum, but to one of the lumbar vertebræ.

Causation.—This dislocation of the lumbar vertebræ is produced after birth by the weight of the body, and, in the majority of cases, it is due to a fall or injury. The displacement is normally prevented by the locking between the articulating processes of the sacrum and the inferior articulating processes of the last lumbar vertebra. It is rendered possible in one of two ways. (1.) By a separation between the anterior and posterior halves of the last lumbar vertebra. This may be due to a failure of development, namely, a want of union between the arch and body of the vertebra, or to a destruction of that union by fracture of the pedicles. The body of the last lumbar vertebra is then displaced forward, leaving the articulating processes behind, and the antero-posterior diameter of the whole vertebra is eventually increased. (2.) By a dislocation forward of the whole lumbar vertebra upon the sacrum. This implies a destruction of the union between the pairs of articulating processes, generally through fracture of the articulating processes of the sacrum.* According to F. Neugebauer,† there may be first a dislocation of the whole lumbar vertebra, and later a separation of the anterior and posterior half, owing to the displaced action of the body-weight. The change in the pelvis is generally produced more or less gradually by the action of the body-weight. It is usually accompanied by inflammatory changes in the bones, and the sacrum and some of the lumbar vertebræ often become fused into one mass. In some cases the spines of the lumbar vertebræ become greatly thickened, and either fused into one mass with each other, and with the spine of the first piece of the sacrum, or united by joints. This proves that excessive weight has been in action, and that it has been transmitted, in part, by the spines instead of by the bodies of the vertebræ.

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* From σπόνδυλον, a vertebra, ὀλίσθησις, sliding or dislocation.

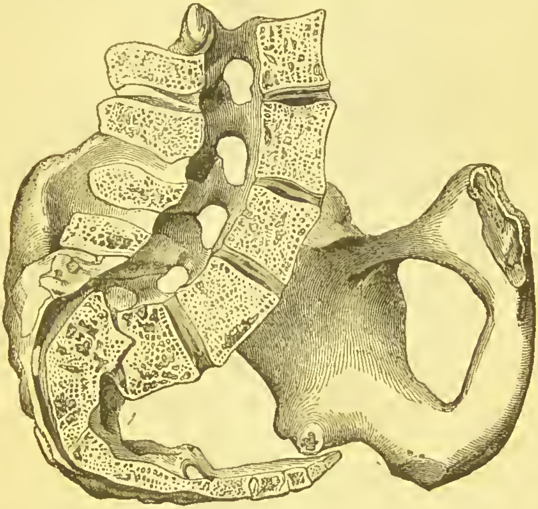

Fig. 203.—Spondylolisthetic pelvis. (After Kilian.)

Resulting changes in the pelvis.—As the whole spine sinks not only downwards but *forwards* over the pelvis, the pelvic inclination must be diminished, to preserve the balance in standing or sitting. The reactions to the body-weight tend to increase the same effect, by pushing the anterior half of the pelvis upward, as in other cases in which the line of incidence of the body-weight is displaced forward, such as the rachitic and malacosteon pelves. In severe cases, such as that shown in Fig. 203, the inclination is actually reversed, the top of the sacrum being lower than the symphysis pubis. The last lumbar vertebra pushes the top of the sacrum backwards (see Fig. 203), and the lower end of the sacrum is thus rotated forward, narrowing the pelvic outlet antero-posteriorly. In severe cases this is increased by pressure on the lower part of the sacrum in sitting. Owing to the diminished pelvic inclination the sacrum sinks deeply, under the pressure of the body-weight, in the direction of the coccyx, separating the ilia. Thus the posterior crests of the ilia are wide apart, and the Dist. Cr. Il. is increased. Increased traction on the sacro-sciatic ligaments, owing to the recession of the sacrum, draws the tubera and spines of the ischium inwards. Also, in consequence of the diminished pelvic inclination, increased strain is thrown upon the ilio-femoral ligaments, as in the kyphotic pelvis (see p. 574), but not to so great an extent, because the body-weight is not transmitted to the pelvis so far back as in that case. The tension of the ilio-femoral ligaments increases the tendency to inward rotation of the spines and tubera of the ischium, as in the kyphotic pelvis. Hence the pelvic outlet is contracted transversely as well as longitudinally.

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* Arbuthnot Lane, however, contends that the whole effect may result from pressure due to carrying weights, and that this pressure alone, acting over a long period of time, may cause absorption and division of the laminæ. Path. Trans., Vol. XXXVI.

† Du Bassin vicié par le Glissement vertébral. Paris, 1884. Also in Obstet. Trans., Vol. XXVI.

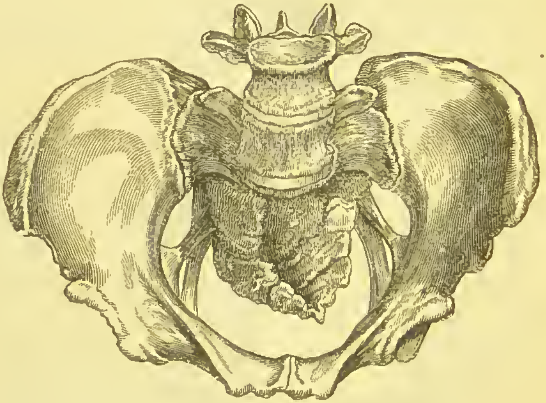

Fig. 204.—Bony growth of the sacrum.

The spondylolisthetic pelvis, in its fully developed form, is very rare, but according to F. Neugebauer, minor degrees of it are commoner than has been supposed. Since the development of the deformity is largely due to carrying excessive weights, it is much rarer in women than in men.

Diagnosis.—There may be a history of injury in childhood or youth, followed by pain in the body, change of figure, and perhaps loss of stature. Walking is affected by the deformity. The buttocks project much backward; the posterior crests of the ilia and top of the sacrum are very prominent, while above is a deep concavity corresponding to the lumbar vertebræ. The edges of the ribs are too near to the iliac crests, the abdomen shortened and prominent. On vaginal examination the prominence produced by the lumbar vertebræ may be distinguished from a projecting sacrum by the absence of the sacral wings. Sometimes the bifurcation of the aorta and iliac arteries can be reached, being displaced much downward. The contraction of the outlet will also be a point of distinction from the flattened reniform pelvis.

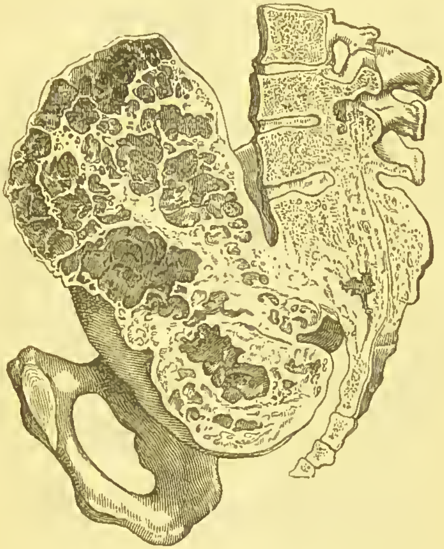

Fig. 205.—Sacral exostosis filling the pelvis.

Prognosis.—Swedelin* has collected the statistics of 19 cases. In these there were 48 deliveries, 31 at full term, 10 induced premature labours, 4 spontaneous premature labours, 3 abortions. Of the 19 mothers 8 died, or 42 per cent., 1 after an abortion, only 3 after Cæsarian section. Of the children 16 passed the genital canal alive, 4 were delivered by Cæsarian section. It is clear from this that in the severer degrees of deformity the obstacle to delivery is very great, but in slighter degrees it may be overcome by the natural powers, or by forceps or version. In some cases increase of difficulty in successive labours has been noted, apparently due to increase in the deformity.

Treatment.—In milder degrees of deformity the choice between induction of premature labour or abortion, the use of forceps, version, craniotomy, symphysiotomy, or Cæsarian section, will be similar to that in the reniform flattened pelvis, the virtual conjugate, measured to the nearest point of the lumbar vertebræ, being taken for the estimation instead of the true conjugate. In more extreme degrees the contraction of the outlet may complicate the question by rendering access with instruments difficult, as well as by impeding the passage of a living child, and so may turn the scale in favour of Cæsarian section.

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* Arch. für Gynäk. Band XXII., Heft 2.

Pelvis deformed by outgrowths.—Obstruction of the pelvis caused by exostosis is rare, but may be so great as to render delivery through the genital canal impossible. The most common situation of growth is the upper half of the sacrum. The growth has then to be distinguished from a projecting promontory by its shape, and by the external measurements of the pelvis. In cases of multiple exostoses throughout the body, there may be multiple exostoses also in the pelvis. These cause more difficulty if they are on opposite sides of the pelvis, and easily cause laceration of the uterus through pressure and friction even when they are comparatively small. The pelvis in such cases is often found to be in addition generally contracted or rachitic,* and the difficulty is thus increased. Growths may be osteo-sarcomatous or cancerous as well as purely bony (see Fig. 207). In the case of rheumatoid arthritis, with bony outgrowths, affecting the hip-joints, osteophytes may form also on

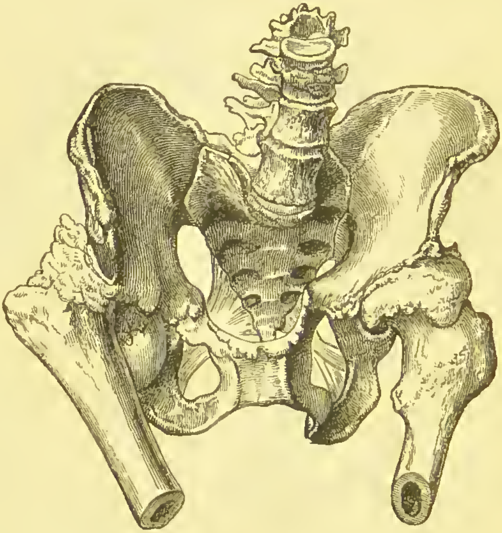
Fig. 206.—Minor degree of deformity from exostosis of the cristæ of the pubis.

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* See Neuenzeit, "Becken mit multipelen Exostosen," Dissert. Breslau, 1872.

adjacent parts of the pelvis (Fig. 206). In other cases spiculæ or ridges of bone projecting inwards may form at the insertion of ligaments or tendons or along the natural edges of bone. These not only occupy some space, but may press upon and lacerate the uterus in labour. Cases are also on record in which the callus resulting from fractures of the pelvis has encroached upon the pelvic cavity, and obstructed labour.

Treatment.—If the growths are bony, they will be incompressible, and the treatment must be decided according to the amount of space left, as in the case of pelvic deformity. If projecting points or edges of bone are detected, the tendency of these to cause laceration of the uterus must be remembered. Much force must not be used in extraction by forceps in order to secure a living child, and there must not be too great hesitation in resorting to embryotomy. In the case of growths filling up the main part of the pelvis, Cæsarian section may be necessary. As a rule, extraction after embryotomy is just possible, if there is a minimum diameter not less than $1\frac{1}{2}$ inches, and a diameter bisecting this at right angles not less than 3 inches; but unless these measures are as much as $2\frac{1}{2}$ and $3\frac{1}{2}$ inches respectively, Cæsarian section is generally preferable as a first choice.

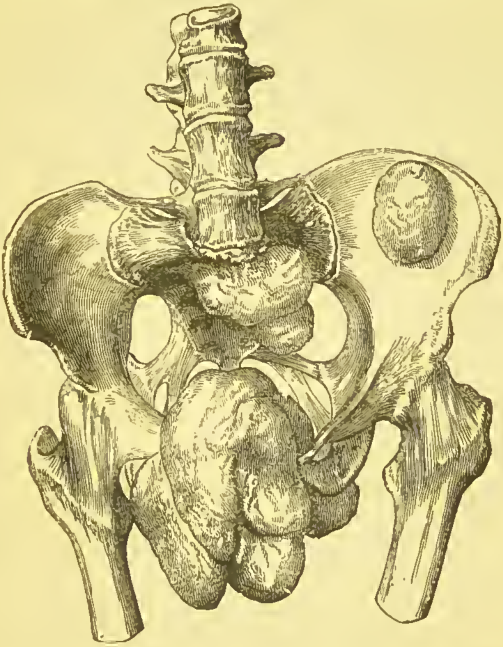

Fig. 207.—Cancerous growths from the bones of the pelvis, causing deformity

28th & 31st week = Premature labour
before that = Premature [illegible].

CHAPTER XXXI.

INDUCTION OF PREMATURE LABOUR AND ARTIFICIAL ABORTION.

INDUCTION OF PREMATURE LABOUR.

THE induction of premature labour, as a conservative operation both for the mother and the child, was first proposed and practised in this country; and, as a means of delivery in cases of contracted pelvis, has generally been held in higher esteem in Great Britain than on the Continent. By induction of premature labour it is intended to save the child, or, at any rate, to give it a chance of surviving. The operation is called induction of artificial abortion when performed at too early a stage of pregnancy to allow this. Induction of premature labour is, therefore, generally performed not earlier than about the twenty-eighth week, and, in most cases, not earlier than the thirty-first week. Before that time there is but little chance that the child will be reared, especially in hospital practice, or when the parents are poor and the infant is not likely to receive the most constant and careful attention. The operation may be called for in the interest of the mother or the child, or in that of both. The following are the principal indications for it.

INDICATIONS FOR THE OPERATION.

(1.) **Pelvic contraction.**—In moderate degrees of pelvic contraction the operation is performed mainly for the sake of the child, but, in some measure also, for that of the mother. The conditions under which it should be undertaken, and the date of pregnancy which should be chosen, have already been discussed (see p. 551). Since the difficulty arises, not from the absolute size of the pelvis, but from its relation to that of the child, even an habitually large size of the fœtus may be, in some cases, an adequate reason for the induction of labour, though no manifest contraction of the pelvis is revealed on measurement. In such cases, if a child has been still-born after difficult forceps delivery, labour may be induced three or four weeks before full term.

(2.) **Diseases endangering the mother's life.**—In this case the operation is performed mainly in the interest of the mother, but it may be undertaken with much less reluctance when the pregnancy is so far advanced that the child is not likely to be sacrificed. It may also conduce to the preservation of the child, which shares in any danger to the mother's life. In cases of eclampsia or placenta prævia there need be little hesitation about proceeding to the induction of labour. Other conditions occasionally calling for the operation are albuminuria, especially when there is much œdema, grave diseases of heart or lungs, hydramnios, severe chorea, pernicious anæmia, ascites, abdominal tumours, and cancer of the cervix uteri. Uncontrollable vomiting, which endangers life, may sometimes be an indication, but this more frequently calls for the consideration of the induction of abortion. It has been proposed by some to induce labour in the interest of the child alone, when the mother's condition is hopeless. This, however, is not generally desirable, since, in most cases, it would risk a shortening of the mother's life, and the mother's welfare should always be considered paramount.

(3.) **Habitual death of the fœtus.**—Habitual death of the fœtus at the certain period of pregnancy, within the last two months, is generally stated as an indication for the induction of labour. It is only, however, in very rare cases that the plan has been adopted with success. Most frequently the cause is syphilis, and in such cases the child would probably be already too gravely affected to survive. Mercurial treatment of the mother would afford a better prospect. Induction of labour may be performed if the cause is probably placental degeneration or inanition, especially when these result from anæmia or some condition other than syphilis in the mother. The operation may be then performed a little before the time at which, from the mother's sensations, the death is presumed to have occurred in previous pregnancies.

METHODS OF OPERATING.

The vaginal douche.—The method of inducing labour by repeated douches of cold or hot water directed against the cervix uteri was introduced by Kiwisch of Wurzburg in 1836. The mode in which this treatment acts is mainly that of exciting the uterus by reflex action, set up partly by the distension of the vagina, partly by the impression of heat or cold. Hot water is the most effective in stimulating the uterus, as is illustrated by its efficacy in the arrest of post-partum hæmorrhage, and thus the douche answers best if used at a temperature of from 110° to 115° F. Besides the reflex stimulus, some effect may also be produced by the water penetrating the cervix uteri, when slightly dilated, and partially separating the membranes in its vicinity. The hot water also tends to soften and dilate the cervix and so assist its dilatation. The injections may be made either with a Higginson's syringe, or with an irrigator elevated above the bed, and of sufficient size to contain about a gallon of water. The irrigator should have a stopcock to the delivery tube. The latter method is the safest. To avoid the injection of any air, a little water should be allowed to flow, and the stopcock turned off, before the tube is introduced into the vagina. The patient should be placed in the dorsal position. At first the irrigations should be employed every three or four hours, and, later, the frequency may be increased if necessary.

This method of induction met at first with considerable favour on account of its apparent simplicity and safety. It is, however, a rather tedious and somewhat uncertain method if the injections are made only into the vagina. If they are made into the uterus, it is not a perfectly safe one, as will hereafter be seen. With the vaginal douche, labour may not be completed for three or four days, or even longer, and the repeated irrigations involve greater disturbance of the patient than is required in some other methods. Moreover, in some cases the presumed perfect safety has not been found to exist, and inflammatory symptoms have been found to be set up after repeated irrigations or injections. This result is probably due to the fact that after the os has been dilated to a certain extent, the nurse is not unlikely to pass the tube within the cervix, and that, if a syringe is used, air is very liable to be injected.

The vaginal douche is, therefore, now not often practised as the sole method of induction, and is generally limited to a preliminary treatment preparatory to the use of other means, especially to the passing of an elastic bougie into the uterus. If the douche is used for about twelve hours at intervals of two hours, it tends to soften and slightly dilate the cervix, and sometimes sets up some commencement of uterine action.

Puncture of the membranes.—Evacuation of the liquor amnii by puncture of the membranes was the earliest method adopted for the induction of labour, and was the method recommended as the result of the great consultation of obstetric physicians in London on this subject in 1756. It is a perfectly certain method, since it never fails to bring on labour sooner or later. It has also the advantage that it can generally be carried out with less inconvenience or discomfort to the patient than any other method. Its disadvantage is that it does away with the fluid wedge of the bag of membranes as a dilator of the cervix. It follows that, although in many cases labour goes on satisfactorily, and the child is saved, yet it may happen that the first stage of labour is protracted, as it is apt to be after spontaneous premature rupture of the membranes. The child is then frequently sacrificed from its exposure to prolonged pressure, unsupported by the liquor amnii, a premature child having less power of endurance than one at full term. This disadvantage has led to the method of puncture of the membranes being abandoned as the ordinary mode of induction of labour when performed mainly in the interest of the child. There are two conditions, however, in which puncture of the membranes is the best method,—namely, eclampsia, in which there is an advantage in relieving the tension of the uterus at once, and accidental hæmorrhage, in which the uterus is stimulated to contract after escape of the liquor amnii. Puncture of the membranes is an uncertain method as to time, and therefore, by itself, it is not adapted for those cases in which speedy delivery is called for. When followed up, however, by artificial dilatation of the cervix it is the most rapid of all methods. In the ordinary case of induction of labour on account of pelvic contraction, in the interest of the child, it should not be chosen.

Introduction of a flexible bougie into the uterus.—This method consists in the introduction of an elastic male catheter or bougie into the uterus between the membranes and the uterine wall. The mode in which it acts is by exciting reflex stimulus, partly by the separation between the membranes and the uterus thus effected, but mainly by the presence of the bougie itself in contact with the uterine surface. Hence the special merit of this method is that labour pains come on in a manner resembling as closely as possible the onset of natural labour, and that the bag of membranes is preserved for the dilatation of the os in the natural way. There is one drawback to the operation, namely, that the bougie may separate the placenta and cause hæmorrhage. But it is found practically that it does not often happen, especially if the bougie is not passed more than about 7 inches within the external os. There is generally room for this length below the placental site. It is also possible that the membranes may be ruptured in the attempt to introduce the bougie, especially if the operator is not very practised. If this happens, the method is simply converted into that of puncturing the membranes, with the difference only that the presence of the bougie furnishes an additional stimulus to reflex action.

The time required for the induction of labour by this method varies according to the height to which the bougie is passed into the uterus, as well as according to the susceptibility of the individual to reflex stimulus. As a rule, provided that the bougie is fairly well introduced, labour pains commence within twenty-four hours, and labour is usually completed within forty-eight hours. Sometimes pains commence immediately, and labour is completed well within twenty-four hours. The method is not adapted for cases in which very rapid delivery is called for, but labour may be accelerated by artificial dilatation of the cervix, as soon as labour pains have fairly commenced.

Mode of operating.—This method is one of the best for the ordinary case of induction of labour in moderate pelvic contraction, in the interest mainly of the child. If the cervix is closed, and high up, hot vaginal irrigations or injections may be employed every two or three hours for twelve hours preceding. These may have the effect of softening the cervix, and inducing some commencement of dilatation. The best instrument to use is not a catheter, which admits air into the uterus through the opening at the end, but a hollow bougie, which can be used with a stylet, if desired. Bougies made of flexible celluloid are more non-absorbent than the ordinary gum-elastic bougies. The bougie should be softened in warm water sufficiently to make it pliant, but it should not be so soft as to double up, and be incapable of any direction. Hands and bougie should be carefully disinfected with perchloride or iodide of mercury, 1 in 1000; and the vagina should also be irrigated with the same solution.

For the operation the patient should be placed at first on her left side. The stage at which the accident of rupturing the membranes is most likely to occur is when the point of the bougie is passing the internal os. The bougie may generally be guided into the cervix, held between the index and middle fingers. If possible, the index finger should be passed up to the internal os, and guide the tip of the bougie between the membranes and the uterine wall, so that rupture of the membranes is avoided. The bougie will generally pass much more readily along the posterior uterine wall than along the anterior, because its direction is more nearly in a line with the cervix and the vagina (see Fig. 69, p. 110). If, however, it can be guided to one side, or somewhat toward the front, there is less likelihood that it will encounter the placenta. If the uterine souffle has been made out as louder on one side than the other, the bougie may be directed towards the opposite side, since the louder souffle probably indicates the side on which most of the placenta lies.

If the cervix is not wide enough to admit the finger, or too high to allow the internal os to be reached, the stylet may be used to facilitate the direction of the bougie until the point has passed the internal os, and reached a safe position between the uterine wall and the membranes. The stylet should have a very gentle curve given to it, considerably less than that of a male catheter. For introduction through the cervix the bougie, made firm by its stylet, is manipulated like the uterine sound. After the point of the bougie is passed through the internal os, the stylet is withdrawn, and the bougie afterwards pushed on without it, until it has passed deeply enough.

For the further passage of the bougie, after its point has once entered the uterine cavity, it is often convenient to place the patient on her back. The index and middle fingers are then introduced into the vagina, the bougie grasped between their tips a little below the cervix, and so gradually insinuated further and further into the uterus until about seven inches have passed. If it is found that it can be pushed on without resistance until the lower end is within the vagina, the support of the posterior vaginal wall will generally keep it in position, without any further means being used. But generally, there will be about five inches outside the cervix, and the lower end will be outside the vulva. Some means should then be adopted to prevent its slipping out. The most convenient is the following. The length remaining outside the cervix is measured by the forefinger, and an equal length is broken off with a pair of pliers from the lower end of the stylet. This piece of stylet is passed into the bougie, thus making rigid only that portion which is outside the uterus, and tapes are fastened to the ring of the stylet. Two of these are carried up in front, two behind, and fastened to a belt round the waist, so keeping the bougie in position.

Bleeding to the extent of a few drops often occurs from the separation of the membranes. If, however, any considerable bleeding occurs, indicating that the placenta has been touched, the operator should abstain from pushing the bougie any further in the same direction. If bleeding continues afterwards to any important extent, the membranes should be punctured.

If labour pains do not come on satisfactorily, the reason generally is that the bougie has not penetrated far enough. It may then, on the following day, be re-introduced, or a second bougie may be passed in a somewhat different direction. If, after the commencement of pains the first stage of labour is long protracted, or if a rising pulse indicates the expediency of accelerating it, hydrostatic dilators should be used to expand the cervix.

Use of hydrostatic dilators.—If the cervix is patent enough to admit one finger, as is not unfrequently the case in multiparæ, dilatation may be commenced by introducing the smallest size of Barnes' dilators (see p. 455). The dilatation sets up pains through reflex action; labour is generally started by the time that any considerable dilatation has been effected, and afterwards goes on automatically. If the pains cease after the smallest dilator has been expelled, larger ones must be introduced afterwards. Most operators find that, when the cervix is small, Barnes' bag and, still more, Champetier de Ribes' bag, cannot be introduced without some previous dilatation, either by tents or mechanical dilators, such as Hegar's. Hydrostatic bags of a smaller size have therefore been used. Thus Tarnier's dilator consists of an india-rubber tube, terminating in a small ball; and this may be used to start labour, being introduced by a special form of sound. At Guy's Hospital small bags made of very thin india-rubber, devised by Dr. Horrocks, have recently been used. The bag, when unstretched, measures about $1\frac{1}{4}$ by $\frac{3}{8}$ inch, and, when dilated, expands into a nearly spherical form. It is used in the following manner.

The bag is tied over the end of a No. 6 gum elastic catheter, and is attached by a rubber tube to the barrel of a large glass syringe, the piston being removed. Antiseptic fluid is poured into the syringe-barrel to test what height is required sufficiently to expand the bag by hydrostatic pressure, and how much the level of the fluid in the barrel must be lowered for this purpose. The bag and catheter are then detached, and by means of a stylet the catheter is passed through the cervix uteri till the bag is within the internal os. The stylet being withdrawn, the catheter is again attached to the tube, the syringe-barrel is filled, and raised until enough fluid has run out to distend the bag to the size previously determined. By lowering the syringe-barrel a little, it is possible to verify that the bag has not burst. For, if it remains intact, the level of the fluid rises again in the syringe-barrel. The bag having been sufficiently filled, the rubber tube is bent back on itself, tied firmly with tape, and the excess of tape cut off. This method of using hydrostatic pressure is illustrated in figure 269.

This method acts rather by exciting reflex action than by directly dilating, although some dilatation is effected if the bag is expelled. It is probably the most perfect method of inducing labour, since it has the advantage as compared with the use of the bougie, that there is no risk of separating the placenta. The only difficulty is to get the rubber-bags made thin enough to dilate easily by hydrostatic pressure and yet strong enough not to burst.

The method is uncertain as regards the time required, like the use of the bougie. Under favourable circumstances labour may be completed in 24 hours, but several days are sometimes required. If the bag bursts, another should be introduced. If it is expelled, and the pains cease, it is generally better to use a Barnes' or Champetier de Ribes' dilator, which the cervix will now admit, since the larger bags of very thin rubber do not answer so well. Frequently labour will go on automatically after the bag is expelled.

Champetier de Ribes' dilating bag, already described (see p. 458), was invented for the purpose of inducing labour. The design is that the bag when placed above the internal os and dilated should assume the diameter, approximately, of a fœtal head, leaving the maternal efforts to expel the foreign body. By this means, not only is the uterus stimulated to contract, but, when the bag is expelled, no further difficulty is experienced from the obstruction of the soft parts.

The inventor declares that, in all his cases, multiparæ and primiparæ alike, he has been able to pass his index finger into the uterus, to strip off the membrane and explore, and satisfy himself as to the direction he should give the bag. Chloroform is to be given if necessary; and, as soon as two fingers can be inserted as far as their first articulation, the bag can be introduced. The further manipulation has been already described (see p. 446).

Besides being used as the primary method for induction, this plan may also be adopted as an adjunct, especially to the introduction of a flexible bougie, or smaller bag, when labour is not set up, or does not progress rapidly enough. The introduction will then be generally facilitated by some dilatation of os having already taken place. This proceeding is especially desirable when the membranes have been accidentally ruptured in the introduction of the bougie.

The following are other methods which have been used for the induction of labour, but are not recommended for adoption.

Oxytocic drugs.—Labour was formerly sometimes induced by oxytocic drugs, such as ergot. Their action, however, is very uncertain, and frequently repeated doses have often been found necessary. A graver objection is that the results to the child are very unfavourable, in consequence of the tonic contraction of the uterus which is apt to be excited. This method has therefore been abandoned.

Electricity.—A Faradic current will cause some contraction of the uterus if sufficiently strong. Involuntary muscular fibre is, however, less readily excited to contraction than voluntary. A uterine contraction cannot therefore be excited by any current which is not strong enough to induce contraction of the abdominal muscles, and so cause considerable discomfort to the patient, besides making it difficult to ascertain whether the uterus really contracts or not. In point of fact a uterine pain cannot be evoked at will by any Faradic current which a patient will readily tolerate. Hence, as might be expected, it does not appear that the use of a Faradic current, without other means, has been successful in inducing labour, although it has been stated by some authorities that they have succeeded in starting labour pains by this means. In conjunction with one of the other methods described, some additional stimulation to the uterus may probably be obtained from a Faradic current. It does not seem, however, that any material advantage can be thus gained unless the current is strong enough to cause considerable inconvenience, and hence the method has not hitherto been found a practically useful one.

Intra-uterine injections.—An effective and also a rapid mode of inducing labour is the injection of a considerable quantity of warm water into the uterus, especially if the injection is made by means of a tube passed up a considerable distance towards the fundus. The method probably acts partly by the direct stimulus caused by the uterine distension, and partly by separating the membranes from the uterine wall over a considerable surface, so that the ovum acts as a foreign body, and excites reflex action. Cohen[*] of Hamburg used a metal tube passed several inches within the os, and injected tar-water in considerable quantity, up to a quart or more, continuing the injection until the patient experienced a feeling of distension. Tyler Smith[†] considered the method superior to all others, and injected as much as a gallon of warm water, passing a flexible tube nine or ten inches into the uterus. Lazarewitch[‡] of Kharkoff still strongly recommends the same method, and uses a flexible tube, passed far up towards the fundus. In some cases, however, these intra-uterine injections have been followed by sudden death. This is a result so extremely unpleasant for the accoucheur, that the general use of the method has been given up, although it is probable that, in very skilled hands, it may be as safe as others. The cause of sudden death is most likely the entrance of air into opened venous sinuses at the placental site. This appeared to be demonstrated in one case at least, which occurred in America, where a Higginson's syringe had been used in the injection of water into the uterus for the induction of criminal abortion. After death, the heart was found full of froth, and it was also found, on testing the syringe, that, in consequence of its not being air-tight, a considerable quantity of air would be injected with the water.

If, therefore, this method should ever be adopted, an ordinary syringe, not a Higginson's syringe, should always be used, and great care should be taken that no air remains in the tube or in the syringe. Seven or eight ounces of warm water would probably be sufficient to produce the effect.

Injection of glycerine.—Pelzer has introduced the method of injecting slowly from an ounce to an ounce and a half of aseptic glycerine between the membranes and the uterine wall by means of a catheter passed through the cervix. He considers that glycerine acts as an excitor of labour in three ways: (1) By mechanical separation of the membranes; (2) by a direct irritant effect on

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[*] Neue Zeitschrift für Geburtskunde, Band XXI.

[†] Manual of Obstetrics, pp. 551—553.

[‡] Obstet. Transact., Vol. IX.

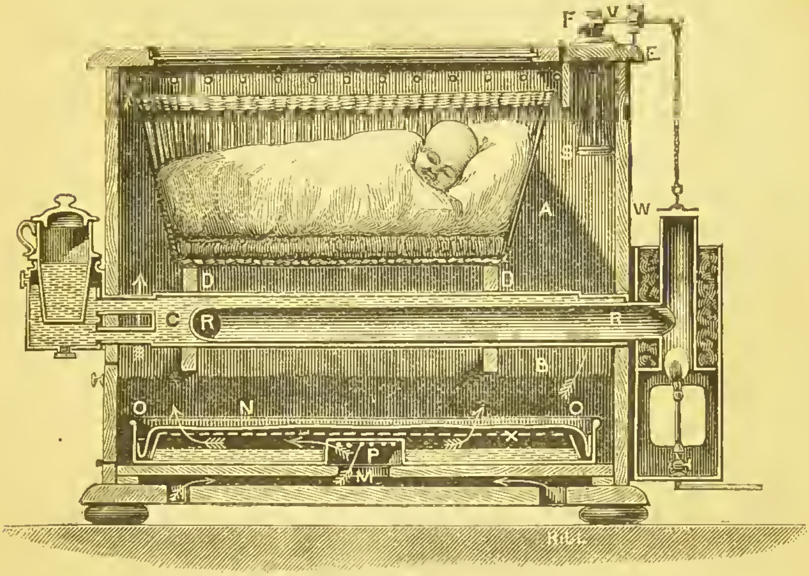

Fig. 208.—Hearson's Thermostatic Nurse.

C. Tank of warm water interposed between upper and lower compartment (A and B). D D. Slips of wood supporting cradle. S. Capsule containing a liquid which boils at the temperature at which it is desired to keep the chamber A. From the centre of the capsule S, a stiff wire passes out through the top of the apparatus, where it comes into contact with a light lever V, which is hinged at F. From the free end of this lever hangs a damper (W), which rests on the top of the chimney under which the flame burns. If the temperature in the compartment A rises too high, the fluid in the capsule (S) boils and expands the capsule, thus raising the wire rod, which, acting on the lever V, at once lifts the damper (W) off the chimney, allowing the heat from the flame to escape by that outlet, and preventing the further heating of the water. M. Aperture for entrance of air. O. Tray containing water. The centre of this tray is raised in the form of a cap (P), which fits over the aperture M, through which the air enters. It is perforated all round its sides, so that the air passes through it horizontally, as shown by the arrows, instead of rising vertically. Another tray (X) of very coarsely perforated zinc, somewhat smaller than the first, is turned upside down within it, and over this is fitted the coarse canvas (N), the edges of which are tucked into the water all round. Thus the air entering is constantly moistened as well as heated. R R. Flue shaped like the letter U, through which the heated air from the flame passes, so as to twice traverse the length of the water-tank, and thus keep the water heated. In the top of the apparatus is a glass window, through which the infant is kept in view. If a higher temperature than the boiling-point of the liquid within the capsule be desired, this can be obtained by moving the weight T along the lever towards the end to which the damper is attached.

the uterine mucous membrane, which excites muscular action as rectal glycerine injections excite contraction of the bowel; and (3) by the affinity of glycerine for water, the liquor amnii being drawn through the membranes, causing more or less collapse.

Vaginal tampons.—C. Braun of Vienna introduced the method of inducing labour by means of a vaginal dilator of india-rubber distended with water. This dilator, under the name of the *colpeurynter*, was for some time considerably used in Germany. The method is, however, uncertain as to time, and unpleasant to the patient. It might be used in the case of hæmorrhage, but, even then, the introduction of a dilator into the cervix would be preferable.

Choice of method.—In ordinary cases, when time does not press, the best methods are the introduction of small hydrostatic bags, or of a bougie. If there is urgent need to effect delivery as rapidly as possible, the membranes should be ruptured, and the cervix then dilated by Barnes' or Champetier de Ribes' bag, after preliminary use, if necessary, of mechanical dilators.

Care of the child.—The rearing of a premature child is the more difficult the earlier is the date of its birth, and often is only possible when minute and unremitting care is expended upon it. Protection from cold is the first essential. In winter, therefore, the child should be wrapped in cotton-wool immediately on its birth, and kept near the fire in a warm room. Care must be taken also not to chill it in washing. If not strong enough to suck, it must be fed for a time with a spoon, the mother's milk being used, if possible, and drawn for the purpose. A warmed box, or "thermostatic nurse" (Fig. 208), on the principle of the chicken-incubator, is made by Messrs. Hearson, of 235, Regent Street, so that a premature child may be kept in the box, which is adequately ventilated, and thus the demand upon its heat-producing power may be reduced. The source of heat is a gas jet or oil lamp, and the box is kept at any uniform temperature that may be desired by an ingenious automatic arrangement. In general, the temperature may be set at 85° F., but it has been made as high as 95° without injury to the infant. As time goes on, it is gradually lowered. The child is kept in the box for some weeks, being taken out only for feeding and washing. It is generally found that it is quiet and happy, under the influence of the equable warmth.

INDUCTION OF ARTIFICIAL ABORTION.

Indications for operation.—Induction of artificial abortion is called for in two classes of cases. (1.) When the delivery of a viable child through the natural passages is impossible, and the induction of abortion offers any advantage to the mother as compared with delivery at full term. (2.) When the mother's life is materially endangered by the continuance of pregnancy, while cutting short the pregnancy is likely to save it.

Hence in all cases in which the pelvis is so obstructed by deformity or the presence of tumours that delivery even by craniotomy is likely to be impossible, or even very difficult and dangerous, abortion should be induced, unless the alternative of Cæsarian section at term is accepted by the mother.

The various conditions endangering the mother's life, and on that account calling for the induction of abortion, have been considered among the diseases of pregnancy. That which most frequently raises the question is severe vomiting in pregnancy. It is only very exceptionally, however, that life is actually endangered, and the physician has often to resist the desire of the patient, who is wearied and exhausted by the malady. The other conditions which may call for artificial abortion are incarceration of the retroflexed uterus when all attempts at reposition fail, albuminuria, jaundice, eclampsia, uterine hæmorrhage, hydramnios, chorea, ovarian or fibroid tumour, pernicious anæmia, and diseases of heart or lungs. Induction of abortion has been performed in chronic phthisis; but the general opinion is that, in general, the effect upon the course of the disease is so doubtful that the operation is not justified. The case in which there need be least hesitation in inducing abortion is that of uterine hæmorrhage sufficient to cause serious symptoms, for there is then very little chance that the ovum can ultimately be saved in any case. In threatened or incipient insanity a delicate ethical question may arise, and each case must be judged on its own merits. But it will generally be held that the sacrifice of the child is justifiable, if there is very strong ground for believing that the mother's reason will thereby be saved. In most cases, however, the interference itself is as likely to be injurious to the mental condition as the continuance of pregnancy.

It should be an invariable rule that artificial abortion should never be induced without a preliminary consultation. This is necessary for the protection of the practitioner himself against any possible imputation of an improper motive.

Choice of time.—If there is a choice of time for the induction of abortion, there are some advantages in undertaking the operation within the first eight or ten weeks of pregnancy, for then the ovum may be expelled unbroken, and the abortion is a less serious matter. If, however, the pregnancy has passed beyond the tenth week, it is better, when circumstances permit, to allow it to continue as far on as possible toward the twentieth week, that the placenta may become more readily separable, and the membranes easier to puncture.

Mode of operating.—Within the first ten weeks of pregnancy, the best method is to dilate the cervix with a laminaria tent, careful antiseptic precautions being taken, and the tent being anointed with an antiseptic lubricant, as iodoform in vaseline (1 in 8) or salicylic cream. If uterine action has not commenced when the tent is withdrawn, several tents may then be placed side by side. Such dilatation will generally call out uterine action, but, if not, the finger may be passed up through the dilated cervix, and the ovum punctured with a sound. Up to the end of the third month, or even later, this will often prove difficult, as the bag of membranes is lax, and does not fill the cavity of the uterus. In this case, a pair of forceps may be passed up into the uterus, guided by the finger, and a piece of the membranes torn away, letting out the liquor amnii. If any considerable hæmorrhage is thus produced, dilatation of the cervix should be completed with Hegar's dilators, and the uterus at once evacuated.

In the later months it is generally better to puncture the membranes at once, since the ovum is not likely to be expelled intact. For this purpose a rather narrow-pointed uterine sound may be used. The point is passed up to the internal os, and directed as perpendicularly as possible to the surface of the ovum. It is then pushed through the membranes by a rather sudden movement. In the later months of pregnancy it is always possible to do this. But up to about four months, if the membranes do not fill the entire uterus, and are lax, as well as tough, it may be impossible, until the cervix has been dilated.

If it is important to evacuate the uterus quickly, as in cases where there is much hæmorrhage, or an offensive discharge, the cervix may be rapidly dilated under anæsthesia, by means of Hegar's dilators.

CHAPTER XXXII.

EXTRACTION OF THE FŒTUS IN PELVIC PRESENTATIONS.

It has already been explained (see p. 252) that, in the management of pelvic presentations, the most important point is to avoid premature interference with nature ; and that artificial aid, beyond that afforded by external pressure upon the fundus uteri, is rarely required before the stage at which the arms have escaped and the head alone is still retained within the vulva, lying, no longer in the body of the uterus, but in the vagina and distended cervix. The mode of extracting the head under these circumstances has also already been described (see p. 254).

Causes of impaction in breech presentation.—Undue protraction of labour, may, however, occur, and interference on that account be called for, at an earlier stage. This may result in breech presentations—(1), from disproportion between the fœtus and the pelvis ; (2), from rigidity of the soft parts, such as is common in primiparæ, associated with more or less uterine inertia ; and, (3), from the attitude of the fœtus. In presentations of a foot, or both feet, the first or second of the causes may be in operation.

In general the limbs of the fœtus in breech presentations are in the same general condition of flexion as in head presentations (see Fig. 106, p. 243), and the feet are close to the breech. Sometimes, however, the legs are extended upon the thighs, so that the feet are above the shoulders, and the toes close to the head (see Fig. 107, p. 244). In this case the whole fœtus may form a wedge with its base uppermost, the dimensions of that base, formed by the head and feet together, being too great for the corresponding diameters of the pelvis. The advance of the fœtus is thereby arrested. Even that part of the wedge formed by the shoulders and arms, with the legs added (see Fig. 107), may be too large to enter the brim, and progress is then arrested earlier. If the trunk of the fœtus is extended, the legs are not long enough to allow the feet to reach up to the level of the head. For the formation of the obstructing wedge, it is necessary that there should be flexion of the fœtal pelvis upon the trunk, owing to flexion of the lumbar and lower dorsal spine. Hence, when one leg is descending in advance, having either presented originally or been brought down artificially, the obstructing wedge is never formed, and it is not necessary to bring down the second leg in order to break it up. For in this case, the position of the thigh in the genital canal causes some extension of the pelvis upon the trunk.

There is also another mode in which extension of the legs causes impaction, or arrest of progress, in breech presentations. When the extended legs lie on each side of the trunk, they form, as it were, splints, keeping the trunk straight, and preventing that lateral flexion of the breech which is essential to its escape under the pubic arch. This cause comes into operation at an earlier stage than that at which the wedge formed by the legs with shoulders or head would be obstructed by the pelvis. If, however, the legs lie at the front of the trunk not at the sides, they do not altogether prevent the lateral flexion, although they must somewhat impede it, the lateral flexion of the breech to one side implying a deflection of the feet toward the opposite side.

It is probable that the position of complete extension of the legs upon the thighs is rarely an original one. The limbs of the embryo, as it grows, are naturally in a position of general flexion, just as the leaves are folded in a bud. But some degree of extension may arise through fœtal movements, and the legs may remain fixed in the extended position if the liquor amnii escapes at the moment when extension exists. It has already been explained that the comparative want of space in the lower segment of the uterus favours a partial extension of the legs during pregnancy. Assuming that, at an early stage of labour, there is a partial extension, like that of the left leg in Fig. 62 (p. 100), this may be increased as the breech descends, the legs being retarded by friction against the uterine wall, and thus the complete extension may eventually be reached.

In a few cases, the extended position of the legs is inferred to be primary, because the legs naturally take that position after the birth of the child, and spring back into it when flexed by the hand.

Allowance has to be made for the fact that, in foot or breech presentations, labour is generally more lingering than in vertex presentations, the half-breech or breech not causing so great reflex stimulus to the pains by its pressure as the head. But interference becomes necessary if the mother begins to show the constitutional effects of protracted labour (see p. 438), or if there is evidence of impending asphyxia of the fœtus. Such evidence may consist of

increased slowness and feebleness of the fœtal heart, or, if the breech has already passed the vulva, of attempted inspiratory movements. After version early extraction is more frequently desirable or necessary than in primary presentations of the foot; first, because 1
the life of the fœtus has often already been imperilled by the condition which called for version; secondly, because the version may have interfered with the natural position of flexion of the arms; 2
and, thirdly, because some pelvic contraction often exists in cases of 3
shoulder presentation.

The delivery of the fœtus in pelvic presentations consists of three stages:—(1), delivery of the trunk; (2), liberation of the arms; (3), extraction of the head. The various means of delivering the trunk will first be considered.

Extraction by the feet.—When one or both feet are already presenting traction on the leg is the mode of acceleration to be adopted. The patient, as a rule, may be kept in the ordinary left lateral position. But, for the final stage of extraction, there is a certain advantage in placing the patient in the dorsal position, across the bed, the buttocks overhanging the edge of the bed, and the feet rested on two chairs. The operator stands between the knees. This position allows an assistant to press more effectively upon the fundus, and the child's trunk to be more easily carried forward in front of the pubes.

If the foot is still in the vagina, the operator seizes it by placing the index and middle fingers in front of and behind the leg, just above the foot, and draws it outside. If necessary, the thumb may assist in grasping it. As soon as the foot is outside the vulva, it is grasped with the aid of a napkin. As the leg descends, the grasp is shifted higher, so that the leg is held as close as possible to the vulva. If pains are fairly frequent, traction should be made during the pains only. In the absence of sufficient pains, the traction should be at intervals, like those of ordinary pains. With each traction firm pressure should be made upon the fundus. The object of this is not only to gain additional force, but to prevent extension of the arms above the head, both by direct pressure, and by stimulating the uterus to contract.

Until the half-breech is resting upon the perineum, the direction of traction should be as far backward as the perineum will allow. This direction of traction will nevertheless be inclined forward in reference to the axis of the brim and that of the upper half of the pelvic cavity. It will therefore assist in rotating the presenting thigh under the pubic arch, and there is no necessity for using any other means to promote this rotation. As soon as the half-breech begins to distend the perineum, the direction of traction must be shifted rather rapidly forward. At this stage, additional force may be gained, if desired, by hooking the index finger of the left hand in the flexure of the other thigh.

If both feet present, they may both be brought down outside the vulva, and grasped together for traction. If, however, the anterior hip does not rotate readily under the pubic arch, rotation will be promoted if the traction is made mainly upon the anterior leg. When both legs come down, it is sometimes found that the funis passes between the legs, and up the back to the placenta. The child is then said to ride upon the funis. In this case an attempt should be made to draw down as much as possible of the funis and slip the loop over one leg. If this attempt fails, the funis should be tied and divided, and the child extracted as quickly as possible.

Bringing down the leg in breech presentation.—If acceleration of labour is called for in breech presentation, the best treatment is to bring down one leg, and then proceed to extract by that leg in the manner just described. When the child is in its ordinary attitude, it is easy to accomplish this, even when the breech has descended low into the vagina, for the feet will be found close to the breech. In general it will not be necessary to give an anæsthetic. If the patient is on her left side, the left hand may be used; if she is in the dorsal position, the hand should be chosen so that its palm corresponds to the abdomen of the fœtus. The foot of the anterior leg should be taken if possible. If, however, the breech is still high up, it is not of much consequence which is taken, for the leg which is brought down will rotate forward under the pubic arch as the fœtus descends.

If the legs are extended upon the thighs, as shown in Fig. 107 (p. 244), the operation is much more difficult. In order to seize the foot, the hand must be passed up higher into the uterus than is ever necessary in version, and even when the foot is seized, there may be much difficulty in flexing the leg, owing to the resistance of the uterine wall. The operation is therefore often more difficult than any ordinary case of version.

The patient should be placed under the influence of chloroform to the full surgical degree, so as to secure the greatest possible relaxation of the uterus. In general, as in the case of version, it is preferable to place the patient on her left side, and introduce the left hand and arm, as corresponding better with the curve of the genital canal. The hand must be cautiously passed up into the uterus, in the interval of pains, as for performance of internal version. The right hand, passed between the patient's thighs, makes counter-pressure upon the fundus. It is no use attempting to flex the leg by the knee. The hand must be passed on quite to the fundus, to reach the instep or foot. It is guided to the anterior foot by tracing up the leg from the breech. It is useless also to attempt to flex the leg directly forward. The foot must be carried toward the opposite side of the fœtus. Thus the right foot should be swept across toward the left side of the chest. The effect of this is to turn the knee outward and evert the thigh. There is then room for the leg in a transverse position, lying flat against the uterine wall.

The operator is to flex the leg and draw it across, by placing the index and middle fingers upon the instep. It is not generally necessary to use the thumb to grasp the foot. If the thumb is used, the closed hand occupies more space in the uterus.

Some eminent authorities have considered that the operation is only possible before the breech has descended into the pelvis, and becomes impossible or dangerous when the breech is low down. There is room however for the leg or thigh to lie transversely across the pelvis, unless there is very great general contraction, and also across the dilated vagina. The chief difficulty is to pass the hand past the breech, when the breech is close to the perineum. Great gentleness and caution are required at this stage.

I have always found it possible to bring down a foot in the manner here described, and have never had occasion to resort to any of the means recommended by many eminent authorities for the treatment of impacted breech presentations, such as the use of the soft fillet, or blunt hook, or the application of forceps to the breech; nor were such means ever found necessary in 389 breech presentations occurring in 23,591 deliveries in the Guy's Hospital Lying-in Charity. The operator might, however, find it impossible to secure a leg, if the uterus were very closely contracted around the child after long escape of the liquor amnii, especially if the breech were close to the perineum, or there were great general contraction of the pelvis.

Digital traction.—The plan of digital traction in breech presentation is one which may be tried, if labour is arrested, when the breech is close to the perineum, before recourse is had to the plan of bringing down a foot. The index finger is hooked in the flexure of the anterior groin and traction made therewith. It may be of service to make the traction alternately on the anterior and posterior groin, and so get the benefit of leverage. If the vaginal space allows, the right index finger may be hooked into the anterior groin, and the left into the posterior.

The soft fillet.—Traction by means of a soft fillet is the best means to employ in the case of failure in the attempt to bring down a leg. The fillet is sometimes passed over one thigh only. In such ease the anterior thigh should be chosen if possible. If the fillet can be passed across both thighs, the pressure is more distributed, and is less likely to injure the skin or soft parts of the groin. It is better still to pass the fillet round the child's pelvis in the following way. A soft oiled handkerchief may be used for the fillet; a knot is to be tied at two opposite corners. By means of the forefinger the corner is to be passed from without inwards over the flexure of the groin till the knot can be reached between the thighs and drawn down. In the same way the opposite end of the fillet is to be passed from within outwards over the other thigh. The centre of the fillet is then slipped up over the buttocks till it surrounds the sacrum, and traction is made by the ends. In this way the pressure is distributed over both groins and the circumference of the pelvis. If the fillet is passed over one or both thighs only, care must be taken, if the abdomen looks forward, that it does not slip up from the groin to the thigh, and so cause fracture of the femur.

In place of the handkerchief a moderately broad strip of oiled lint may be used. A still better fillet may be made of a piece of thick-walled india-rubber tubing about the size of the little finger. A strong piece of tape is passed through the tube and sewn to the tube at each end, the ends of the tape projecting beyond the tube. The knotted ends of the tape are then passed over the flexures of the groins from without inward as before.

If the fillet cannot be passed over the thigh by the index finger, a large gum-elastic catheter, with stylet, may be bent to a suitable shape, resembling that of the blunt hook, and passed from without inward over the thigh, having a tape attached to its extremity. By means of the tape, the fillet can then be drawn into position. A special instrument, or porte-fillet, has been made for this purpose, on the principle of Bellocq's sound, used for plugging the posterior nares, but having a curve like the blunt hook. A long piece of whalebone runs through the central canal.

Traction by means of the soft fillet generally so far breaks up the opposing wedge as to allow the fœtus to pass, unless there is great disproportion between fœtus and pelvis. For the traction on the flexures of the groins diminishes the flexion of the fœtal pelvis upon the trunk, and by this means brings the feet below the level of the head.

The blunt hook.—The blunt hook is an instrument constructed expressly for extraction in breech presentation. It is not, however, desirable to use it, in the case of a living child, unless all other means have failed, on account of the injury which it is liable to do to the skin and soft parts of the groin. The instrument is generally made of steel, and the diameter of the semicircular curve forming a hook is about two inches. The likelihood of injuring the groin will be less, if, at the time of use, a piece of india-rubber tubing, fitting the hook closely, is slipped over it. The tubing should be new for the occasion.

It is better to place the hook over the anterior thigh. It is passed up, lying flat against the thigh, the point directed toward the front of the fœtus. When high enough the point is turned inward, and passed over the flexure of the groin. Care must be taken to feel the point lying clear between the thighs, before traction is made. When the fœtus is dead, the blunt hook is a good means of traction, and will generally succeed in sufficiently decomposing the obstructing wedge, by bringing the feet below the level of the head. It can rarely, however, be certainly known that the child is dead, unless the funis is within reach.

Forceps.—The application of forceps to the breach has been recommended by some eminent authorities. Forceps specially adapted for this purpose have even been devised, and have been distinguished by the title of "retroceps." Forceps of any form are, however, unsuitable for holding the breech. The tips of the blades cannot be approximated without risk of injury to the fœtus. If they remain divergent, there is a very wide space between the centres of the blades. In consequence of this, not only are the forceps apt to slip off, but injury may be done to the maternal tissues. Lusk, however, speaks highly of the application of Tarnier's axis-traction forceps to the breech, one blade being applied over each thigh of the fœtus.*

If extraction by forceps is attempted at all, it should only be after the breech has descended into the pelvis. If the breach has rotated, one blade should be applied over the sacrum, the other over the anterior surface of one thigh, care being taken not to injure the genitals of a male. If the breech has not rotated, it is recommended to apply the blades over the lateral surfaces of the thighs.

Bringing down the second leg.—If the child is dead, and extraction is difficult on account of disproportion between fœtus and pelvis, it is desirable to bring down the second leg, as there is then no object in keeping the half-breech as a dilator for the soft parts. In such cases, the cephalotribe, applied over the pelvis, will afford, if necessary, a very powerful hold for traction. Both legs should be brought down, if possible, before its application. The crochet, hooked over the symphysis pubis, may also be used in conjunction with traction on the legs. If there is any morbid distension of the abdomen (see p. 502) perforation of it may be required.

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* "The Science and Art of Midwifery," 2nd ed., p. 380.

Liberation of the arms.—The second stage in extraction consists in the liberation of the arms. When it has been necessary to accelerate labour by traction, the arms are retarded by friction against the genital canal, and generally become more or less extended by the side of the head, instead of lying folded across the chest as shown in Fig. 109 (p. 249). They then do not slip out from the vulva before the shoulders under the influence of the natural force, but have to be released artificially.

When the legs of the fœtus have escaped, the pelvis should be grasped in two hands, and used for traction. Traction should still be made with the pains if possible, and should be assisted by pressure upon the fundus uteri. As soon as the funis can be reached, a loop of it should be drawn down, as in normal cases of pelvic presentation to prevent its being put upon the stretch, and should be placed opposite one sacro-iliac synchondrosis, where it is least exposed to pressure. Traction should be continued until the shoulder-blades begin to reach the vulva; then is the time for releasing the arms.

In easy cases, when the arms are only slightly extended, the anterior arm should be released first, but, in difficult cases, always the posterior. For, if the anterior arm is below the brim, it will be very close to the vulval outlet, and can be easily hooked by the finger. If however one or both arms are partly above the brim, the posterior is the easier to seize. For as the trunk descends in the direction of the pelvic outlet, the posterior shoulder is necessarily lower than the anterior in reference to the plane of the brim. There is also more room posteriorly for the hand to be passed up to reach it. For release of the posterior arm, the body of the child should be held as far forward as possible in front of the pubes. The patient being in the left lateral position, the fingers of the left hand should be introduced.

If the extension of the arms is only moderate, the elbows will still lie in front of the chest, below the head, and the release of the arms is then easy. Four fingers of the left hand are passed within the vulva, lying flat against the shoulder. The fingers are run along the arm till the elbow is reached, and then the index and middle fingers draw the elbow downward and forward across the chest. Care must be taken that the fingers quite reach the elbow, and do not make the pressure upon the middle of the humerus; otherwise the humerus is likely to be broken.

For release of the anterior arm, the body of the child is held as far backward as possible; and the fingers of the right hand are introduced, and release the arm in a similar way. If the patient is in the dorsal position, that hand may be introduced the palm of which corresponds to the abdomen of the child, for liberation of each arm.

Liberation of the arms when much extended.—Sometimes the arms are found completely extended by the side of the head. They may then become jammed with the head in the pelvic brim, especially if there is disproportion between the fœtus and pelvis. Liberation is then much more difficult, both on account of the fixation in the brim, and on account of the difficulty of reaching as high as the elbow.

Sometimes one arm is not merely extended beside the head, but displaced somewhat behind it, and then the difficulty is greater still. This position is due to a rotation of the trunk in its descent, in which the arm has been left behind. The remedy is to rotate the trunk back again in the opposite direction and so bring the arm across the face. The same proceeding will facilitate the liberation of the arm even if only extended by the side of the head. The posterior arm is to be liberated first as in the former case. The trunk of the fœtus is, therefore to be grasped with two hands and turned in such a way as to rotate the posterior shoulder towards the back of the fœtus. The fingers must then be passed quite up to the elbow, and the elbow must be drawn downwards and across the face of the fœtus towards its opposite side.

When the anterior arm is extended above the brim, it is difficult to reach the elbow, the fœtus being tightly pressed against the symphysis pubis. To overcome this difficulty, the trunk of the fœtus should be rotated, so as not merely to reverse the former rotation, but to carry the anterior shoulder backward to the side or posterior part of the pelvis, and so convert it into the posterior shoulder. The arm is then drawn across the face, and is in a position more easily accessible. The release of the arm, originally posterior, will generally allow the fœtus to descend lower. The trunk should, therefore, be drawn down as much as possible. The best mode of rotating the shoulders is to make use of the released posterior arm and draw it forward across the chest toward the symphysis pubis. Thus, in a position like that shown in Fig. 110 (p. 249), the left arm should be drawn forward across the chest on the left side of the mother, so as to bring the left shoulder towards the symphysis pubis.

If the patient is on the left side, the left hand may be used for the release of both arms, provided that the anterior shoulder is thus drawn backward. If she is in a dorsal position, the hand whose palm corresponds to the abdomen of the fœtus should be used for the posterior arm, the other hand for the anterior arm, after the shoulder has been rotated backward.

If the child descends with the abdomen looking directly forward, and the arms cannot be brought down between the thorax and the symphysis pubis, the thorax should be rotated so as to bring one shoulder backward, and the corresponding arm should be brought down first.

If the child is certainly dead, and the arms cannot be brought down by the fingers, the small blunt hook, recommended for securing the knee in version, or the crochet, may be used to secure them. In this case it is of little consequence if the humerus is fractured.

Delivery of the head.—The third stage in the extraction of the fœtus consists of the delivery of the head. The delivery of the head through a contracted pelvis has already been described (see p. 548). The extraction of the head when detained only by the soft parts of the vaginal outlet has to be carried out in the same way as in a normal case of pelvic presentation, and has been described at pp. 254—257.

Injuries to the fœtus from extraction in pelvic presentation.—Effusions of blood in the abdomen from damage to the liver or other viscera, are sometimes found, as are also effusions of blood in the brain or its membranes. Effusions of blood may also take place in the breech or genitals. The genitals of a male may be injured by fillet, blunt hook, or forceps. From traction of the neck may result hæmatoma in the sternomastoid or other muscles of the neck. This generally disappears without eventual ill result, but sometimes cicatricial contraction leads to wry-neck.

Injuries to the cranial bones, due to the pressure of a contracted pelvis, will be described hereafter (see Chap. XXXVII.). The cervical vertebræ may be separated, and the spinal cord or medulla destroyed, from the effect of traction upon the neck. Sometimes even the body may be completely pulled away and separated from the head, but the spinal column gives way long before the soft parts. By jaw-traction may be produced fracture of the lower maxilla, dislocation of the maxillary joint with rupture of ligaments, and also injury to the floor of the mouth.

In attempts to release the arms the humerus may be broken near the middle, one of its epiphyses may be separated, or the clavicle may be broken. The most likely lesion to be produced by traction on the leg is separation of the lower epiphysis of the femur; but this is not common. The so-called congenital dislocation of both hips (see p. 534) has been ascribed to traction on the legs in pelvic presentations, but is really a fault of development.

A fractured humerus may be set with softly padded splints, the outer splint extending the whole length of the arm. The arm should be secured to the side.

CHAPTER XXXIII.

THE FORCEPS AND VECTIS.

USE OF THE VECTIS.

THE vectis is one of the simplest forms of instrument which can be used for the extraction of the head, but its use has been, in general, abandoned in favour of that of forceps, which is found to be both a safer and more effective instrument. The vectis consists of a handle and single blade (Fig. 209), having a cranial, but no pelvic curve. It somewhat resembles a single blade of a pair of straight forceps, except that the cranial curve is much sharper, especially near the extremity of the instrument, in order to enable it to take a better hold of the head. Thus the tip of the blade is inclined at a greater angle to the axis of the instrument than is the case with forceps. It is sometimes stated that a single blade of a pair of forceps will answer the purpose of the vectis just as well as the vectis itself, but this is not the case, on account of the difference in curvature.

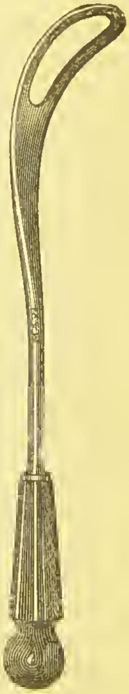
Fig. 209.—The vectis.

The vectis is generally said to act both as a lever and a tractor. Its essential action, however, is that of a tractor applied to one portion only of the head. A leverage action is indeed called out when the vectis is used in the manner formerly recommended, the lever being the head itself. The plan recommended was to place the vectis over the forehead and occiput alternately, and by this means draw down a little first one extremity and then the other of its long diameter. In this action the opposite end of the head to that at which the vectis is applied is generally fixed by friction, and so forms a fulcrum. The power is the traction force applied through the vectis; the resistance may be considered as acting at the centre of the head, which advances a little at each application of the vectis, and lies therefore between the power and the fulcrum. This method of extracting the head by drawing down first one extremity and then the other is analogous mechanically to that of getting a cork out of a bottle by pushing first one side and then the other, and also to that oscillatory or pendulum movement in extracting by means of forceps, which will be considered hereafter. Although it often may answer the purpose, yet the repeated introduction and withdrawal of the instrument are more likely to do injury than straight traction with forceps. The process is also troublesome and often ineffective, since no great force can be exercised. The use of the vectis in this way has therefore rightly been given up.

The vectis in occipito-posterior positions.—The vectis is now practically regarded by most authorities as an obsolete instrument. There is one condition however, in which precisely that power is wanted which the vectis is able to exercise, namely, the power of drawing one pole only of the head in any required direction. This is when labour is arrested or protracted in occipito-posterior positions of the vertex, and the occiput fails to rotate forwards. The rotation may then be effected either by a force actually directing the occiput forward, or by one which causes flexion, since it is through defect in flexion that the inclined plane of soft parts fails to turn the occiput forward as usual (see pp. 183, 184). Both these indications are fulfilled by the use of the vectis. If the vectis is applied over the occiput and traction made towards the vaginal outlet, as much forward as possible, first, flexion is promoted by the descent of the occiput, and, secondly, the occiput is directly drawn forward, since the vaginal outlet is directed forwards in reference to the direction of the pelvic axis at the point where the centre of the head is lying (see Fig. 16, p. 18). I therefore consider that the vectis has fallen into unmerited disuse, so far as regards this particular case. Even when called in to perform craniotomy, after vigorous efforts to extract with forceps had failed, I have found that the occiput could be turned forward by the vectis with surprising ease, and that then extraction by forceps presented no difficulty whatever. It is generally recommended that forceps should be applied in such a case, and the head drawn down in its existing position. The result almost always is that the occiput remains posterior, although, if the descent of the head had been effected by the natural powers, the occiput would probably have rotated forwards at a late stage. Hence, although the extraction may be successful, yet it requires more force than if the head had been in the usual position, and there is a much greater probability of laceration of the perineum. When used in this way to draw down the occiput, the vectis does in fact itself form a lever as well as a tractor, although the leverage should only be just what is necessary to secure the tractile force. For, the blade being single, the inclined plane formed by its distal portion pushes the head toward the centre of the pelvis, at the same time that the vectis itself is pushed against the pelvic wall. To avoid this pressure on the pelvic wall, a pressure different from any produced in forceps delivery, while downward traction is made by the right hand on the handle of the vectis, the left hand should be placed on the shank, as high up as it can reach, and press it towards the centre of the pelvis, or at any rate resist the pressure away from the centre of the pelvis which the traction calls into play. The fulcrum of the lever here lies between the power and the resistance, and is formed, as far as possible, by the left hand, and not by the pelvis or soft parts. It is obvious that the pressure toward the centre of the pelvis exerted upon the occiput is beneficial, since it aids in producing flexion, whenever the occiput is in any degree lower than the forehead (see Fig. 85, p. 178)

The vectis is introduced in the same way as one blade of the forceps. The patient is placed on the left side, the left hand or half hand is introduced into the vagina, and the tips of the fingers placed upon the occiput, just within the rim of the cervix, if the cervix is not completely retracted. The blade is passed up with its convex side under cover of the flexor surface of the fingers, and is thus guided over the head. The blade will generally have to be directed nearly in the direction of the sacro-iliac synchondrosis, or somewhat in advance of that point. It will be somewhat more difficult to pass than a blade of the forceps, on account of its greater cranial curvature. If difficulty is found, the handle should at once be carried well forward between the thighs, so that the blade passes almost up the hollow of the sacrum. The blade is then rotated into its position over the occiput, by depressing the handle, if the occiput lies to the right, raising it, if it lies to the left, while at the same time the blade is guided by the fingers in the vagina.

It need scarcely be said that no one should attempt to use the vectis in this way in occipito-posterior positions who cannot rely upon his capacity to diagnose with certainty the position of the head. If the forehead were mistaken for the occiput, harm would result instead of good. As soon as the occiput has been brought to look somewhat forward instead of backward, the vectis may be removed, and delivery completed by forceps. If, however, there is no occasion for hurry, it is well to allow a short time for the new moulding of the head in its changed position to take place. Delivery also may sometimes be completed by the natural powers, when once the position of the head has been rectified. There is one condition in which the use of the vectis, as above described, is not available. This is when the head is already distending the perineum, and so close to the outlet of soft parts, that there is no longer room for the combined movement of rotation with flexion to be effected by drawing the occiput downward and forward, especially when, as will usually be the case at this stage, the occiput has rotated backward into the hollow of the sacrum. If the head is still high in the pelvis, the vectis, applied over the occiput, may fail to rotate it. For, in this case, the forward inclination of the line of traction, in reference to the axis of the brim, is but slight and the component of the force available in producing rotation is comparatively small. In such a case it is better to draw down the head first with forceps, especially if it is still considerably overlapped by the edge of the os uteri, until it has nearly reached the floor of the pelvis, and is clear of the os uteri. The forceps may then be taken off, and the vectis applied, in order to produce the rotation, which, at this stage, will rarely fail.

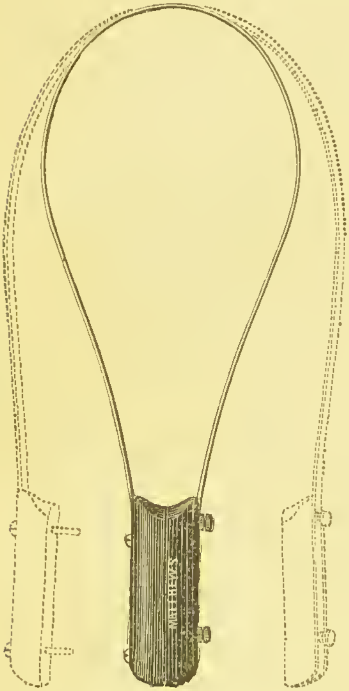

Fig. 210.—The fillet.

The vectis in brow presentation.—A much more rare contingency, in which the vectis may sometimes be of use, is that of brow presentation. By applying the vectis over the occiput, an attempt may be made to convert the presentation into a vertex. If this fails, the vectis may be applied over the chin, and another attempt made to convert the presentation into a face.

THE FILLET.

The whalebone fillet (Fig. 210) was another instrument intended to exercise traction upon one pole of the head. It was in use at an earlier date than the forceps, but is now, with greater justice than the vectis, considered obsolete. If placed over the chin, it might obtain a firm hold, but would be likely to produce premature extension. If placed over the occiput, it would be much more likely than the vectis to slip off. The fillet is now worthy of notice on one account only, namely, that it would be possible for an accoucheur to improvise the instrument out of a strip of whalebone, in the unlikely contingency that he had to deal with a case of protracted labour, and could not obtain instruments.

THE FORCEPS.

History.—The midwifery forceps were invented by Peter Chamberlen, born in 1601, who, with his three sons, long kept the invention a secret for their own benefit. The existence of a secret method for saving the lives of infants in difficult labour was first mentioned in a pamphlet published in 1647. The invention gradually became known, but it was not until 1735 that Chapman, in a treatise on midwifery, published a description and plate of the instrument.

The forceps of Chamberlen did not essentially differ in mechanism 173 from the instrument now known as the short straight forceps (Fig. 211, p. 610). Each blade is straight, viewed in profile, but has a cranial curve to grasp the head, the curve starting immediately from the lock. The blades are fenestrated, to lighten the instrument and allow the head to bulge through the fenestræ; the handles are of metal, and looped somewhat like the handles of scissors. The lock of Chamberlen's forceps was formed by a fixed pivot upon one blade, which fitted into a depression or mortise on the other blade. This lock had to be secured by tape tied round it, to prevent the risk of the blades separating. It is, in fact, the embryo of the lock still used in French, German, and some American forceps (see Fig. 203), in which the pivot is surmounted by an adjustable screw, which prevents lateral separation at the lock, and allows the tightness of the lock to be adjusted by turning the screw. This adjustable screw was first added by Levret, who published a treatise on midwifery in 1766.

The lock known as the English lock (Fig. 202), which allows the blades to be joined much more easily than any other, and is sufficiently firm for all purposes, was invented by Smellie, who also covered the handles with wood, for greater convenience in grasping. Smellie's forceps thus closely resemble the short straight forceps in use up to the present day (Fig. 202).

The pelvic curve.—The short forceps are only capable of grasping the head when near the perineum, or after its descent into the cavity of the pelvis. In order to grasp the head when arrested at or above the brim, a longer instrument is necessary. Length may be attained by making the shanks parallel for a certain distance beyond the lock before they diverge into the cranial curve. The instrument

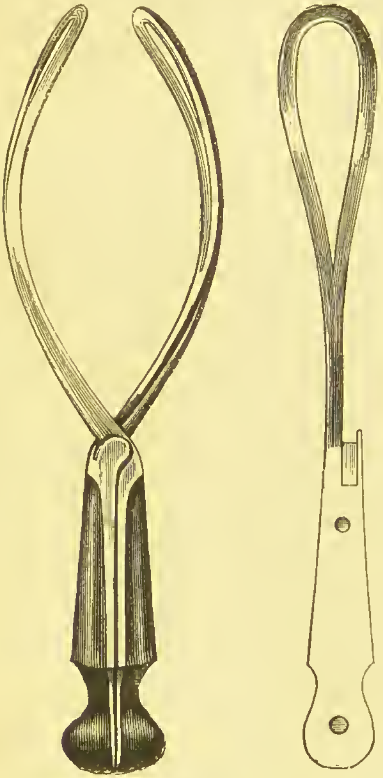

Fig. 211.—Short straight forceps.

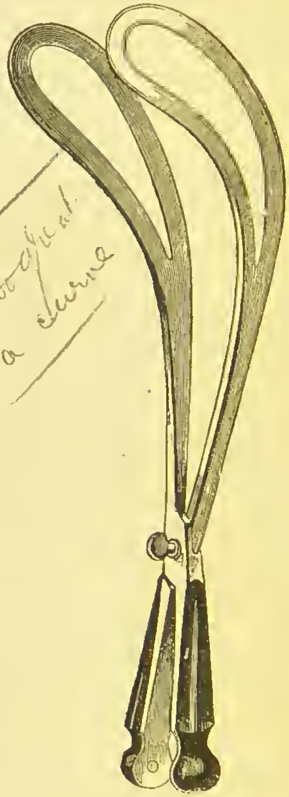

Fig. 212.—Short curved forceps, with French lock.

Too great a curve

thus formed constitutes the long straight forceps (Fig. 213, p. 611). It is possible to apply it to the head even when high in the pelvis; and at the Rotunda Hospital, Dublin, up to a comparatively recent date, namely, up to the mastership of Dr. G. Johnston, commencing in 1868, this instrument was in use even for the high forceps operation. A straight instrument is still preferred for all cases by Prof. Lazarewitch of Kharkoff. If, however, long straight forceps are applied to the head at or above the brim, the blades can neither grasp the head in the axis of the brim, nor can traction be made in the direction of that axis. For the axis of the brim (O P, Fig. 16, p. 18) passes behind the tip of the coccyx when that bone is in its undisplaced position, whereas the resistance of the perineum, even when pressed backward to the utmost, must push the shanks of the forceps at the vaginal outlet much further forward than this point. Practically the inclination of the axis of the forceps to the axis of the brim cannot be less than about 20°. In flattened pelves, especially when the pelvic inclination is increased, the axis of the brim is sometimes directed further back than usual, and the deviation of straight forceps from the desired direction is then still greater. The result is that, when traction is made, the tips of the blades, being posterior to the axis in which the head has to move, are apt to slip off the head posteriorly. Also the perineum is liable to be injured from the pressure made upon it in retracting it to the utmost extent. The difficulty thus caused by the perineum is overcome by giving the forceps an additional curve, the pelvic curve (see Fig. 212, p. 610, Figs. 214, 215, p. 615, Fig. 216, p. 616). In this way are constituted curved forceps, long or short, as the case may be.

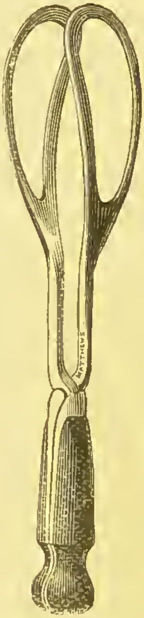

Fig. 213.—Long straight forceps.

The invention of the pelvic curve has generally been ascribed to Levret, or to Smellie, who adopted it almost simultaneously. It appears, however, to have been previously used, although not published, by Benjamin Pugh, of Chelmsford. Levret's forceps, introduced about 1747, were long and powerful curved forceps with iron handles, and the French, or pivot and mortise, lock. Benjamin Pugh, in a treatise published in 1754, gives a figure of his long curved forceps, closely resembling the long curved forceps now in use, and states that he had invented them upwards of fourteen years before, and was accustomed to apply them to the head even when detained above the brim of the pelvis.

The long curved forceps are able to grasp the head in the axis of the brim even when the head is arrested quite high up above the brim (see Fig. 216, p. 616). But not only is their power of prehension superior to that of straight forceps, but they are much easier to apply. For each blade passes more readily along the genital canal, in consequence of its having a curvature corresponding to that canal, so that the tip of the blade always passes in advance. But when a straight blade is passed along a curved canal, the point which leads the way is not the tip of the blade, but a point more towards one side, and the introduction is then not so easy. The advantage gained by long curved forceps is strikingly shown by the diminution of the proportion of craniotomy cases at the Rotunda Hospital, Dublin, after their adoption by Dr. G. Johnston. Dr. G. Johnston's proportion of craniotomy cases was only 3·5 per 1,000, whereas under C. Johnson (1840–1847) it had been 7·9 per 1,000, and under Shekleton (1847–1854) it had been 7·2 per 1,000. It was therefore reduced to less than one-half of what it had formerly been. Similarly in the Guy's Hospital Charity, mainly owing to the introduction of longer, firmer, and more effective forceps, the proportion of craniotomy cases was reduced from 3·6 per 1,000 in the interval 1833–1854 to 1·2 per 1,000 in the interval 1854–1863, and to the extremely low proportion of 0·7 per 1,000 in the interval 1863–1875. The ordinary long curved forceps will still be found the best instrument, if an instrument is wanted for general use in all cases.

Axis traction forceps.—The ordinary long curved forceps have the disadvantage that the direction of traction is apt not to be that in which the head is grasped, and in which it has to advance, but one inclined more anteriorly. When the handles are held in one hand this is indeed inevitable, since the line of traction must necessarily be a straight line from the centre of the head to the point at which the handle is held. This line will make an angle of from 22° to 25° with the axis of the brim, if the pelvic curve of the forceps does not exceed 35°, and the forceps are held near the end of the handles. If the forceps are grasped at the lock, the deviation is somewhat less. The deviation of the line of traction from the right direction is therefore slightly greater than in the case of long straight forceps. The consequence of this is that rather less than one-tenth of the tractile force exercised is lost as regards its effect in causing advance in the axis of the brim, and a useless and injurious pressure is exercised on the anterior pelvic wall, equal to more than two fifths of the tractile force.* The latter effect seems to be of more importance than the former, since the ratio to the traction exercised is more than four times as great, and, moreover, the loss of one-tenth of the force in ordinary cases is not of much consequence, since there is usually a sufficient reserve of power which may be put into action.

It will be shown, however, hereafter, that by the use of two hands in traction the force exercised may be made to act accurately in the axis of the brim, a fact which has been rather overlooked by the advocates of axis-traction forceps.

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* The exact proportion in the former case, taking the angle at 25°, is 1 − cos. 25°. or ·0936922, in the latter, sin. 25° or ·4226183.

To avoid the disadvantage of an incorrect direction of traction, a third or perineal curve has been added to the forceps, so as to make the shanks and handles curve backward again round the perineum, until the part of the handles to which traction is applied either approximates more or less to the axis of the blades or lies exactly in that axis. In the latter case traction can be made precisely in the axis of the brim, or of any other part of the pelvis in which the head may lie. By the axis of the blades must be understood the axis of the extremities of the blades, since it is by this part of them that the propulsive force is mainly applied to the head.

A slight inverted curve has been given to the shanks of the forceps by various authorities, of whom the earliest appears to have been Dr. Robert Wallace Johnston, who published a "System of Midwifery" in 1769. Hubert, in 1860, bent the handles of his forceps back almost at right angles till their extremities nearly reached the axis of the blades. Aveling, in 1868, introduced forceps with the handles curved backward, so that the whole instrument has a sigmoid shape. The inverted curve is not, however, carried far enough to meet the axis of the blades. Moralés of Belgium, in 1871, gave an inverted curve to the shanks and first part of the handles, finishing the handles with a straight portion. In this case also, the inverted curve was not carried far enough to meet the axis of the blades. Tarnier, in 1877, introduced his now well-known axis-traction forceps (Fig. 224, p. 642). In these, for the first time, the cross-bar by which traction is made lies accurately in the axis of the blades, and a new principle is also introduced, namely, to make the traction, not by the handles of the prehensile blades, but by traction rods jointed to them in a line with their axis. Tarnier's forceps first called general attention to the principle of axis-traction, and various modifications of them have since been introduced.*

Mechanical action of forceps.—It is frequently stated that the action of forceps is threefold, namely that of a *tractor*, a *lever*, and a *compressor*. The essential action, however, is that of a tractor only. To carry out this action it is essential that the instrument should be so constructed as to be capable of maintaining a firm hold of the head without slipping. The two blades of the forceps also form a double lever like a pair of scissors, the fulcrum being at the lock. The action of the double lever is to compress the head. This compression

TRA
LEVE
COMP

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* For historical sketches of the various forms of forceps, see Tarnier, "Description de deux nouveaux Forceps," Paris, 1877; and Aveling, "The Curves of Midwifery Forceps, their Origin and Use," Obstet. Trans., Vol. XX.

of the head, however, is not one of the objects aimed at in the use of forceps, but is, on the contrary, generally injurious, and should only be carried so far as is necessary to secure a firm hold. For the blades of the forceps being generally applied at the sides of the pelvis, or nearly so, the compression of the head in the transverse diameter of the pelvis tends to bulge it out in the conjugate diameter of the pelvis, where there is generally least room for it. It is only therefore in the comparatively rare cases of transverse contraction of the pelvis that the action of the forceps as a compressor is directly advantageous. Besides the double leverage causing compression, another kind of leverage may be exercised, not when simple traction is used with forceps, but only when an oscillatory or pendulum movement is made with the handles, the head being grasped tightly enough to form an immovable mass with the two blades. In this case the lever is formed, not by one blade of the forceps, but by the whole mass of the head with the two blades. It will be seen hereafter that the oscillatory movement in traction is not generally desirable, though recommended by many authorities.

Requirements of good forceps.—In the days when the application of forceps was looked upon as a grave operation, not to be lightly undertaken, many obstetricians, especially English obstetricians, deliberately chose a weak instrument, that they might not be tempted to exert too much power with it. Hence forceps with short handles, and thin shanks and blades, were much in use. In France, on the contrary, the pattern of Levret's forceps was extensively followed, and the instrument was made strong, with long handles. A weak instrument is, however, really more dangerous to the mother and child than a strong one. If the handles are not long enough, and the shanks and blades stiff enough, to maintain the hold on the head under strong traction, the blades slip off the head, and diverge at their widest part, thus causing pressure on the lateral pelvic walls. At the same time the tips of the blades, as they slip off, are liable to injure the head, and possibly even the maternal soft parts, if they slip off anteriorly. Good forceps, therefore, should have moderately long handles (not less than five inches from the lock), and should be as stiff as possible. The quality of stiffness should be tested by holding the handles firmly together, and trying how far the tips of the blades can be separated by the finger and thumb. The advantage to be gained by stiffness is only limited by the consideration that the blades must not be made so thick as to occupy too much space in the pelvis. In the shanks a little extra thickness of metal may be employed without any drawback. The cranial curve should be of medium sharpness, so that the elongated head of average size may be grasped uniformly, and not excessively compressed either at its centre or at its extremities. A curve equivalent to the arc of a circle nine inches in diameter is found to be generally the best. If the curve is too sharp, the forceps are more difficult to introduce, if it is too flat they are more apt to slip off the head, and, in both cases, the head is unequally compressed. The tips of the blades should be about an inch apart when the handles are closed, that they may not be liable to injure the head or neck by their pressure. The outside measurement across the blades at their widest part should not be greater than

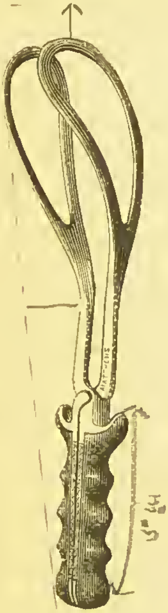

Fig. 214.—Simpson's forceps.

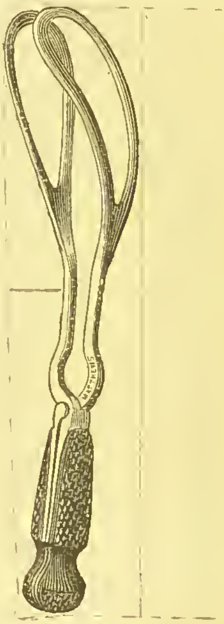

Fig. 215.—Barnes' forceps.

3⅜ inches. The measurement is of course increased somewhat beyond this magnitude when the forceps are in use, if either the head is too large to allow the handles completely to close, or the blades and shanks yield somewhat under the traction exerted.

In long curved forceps, the length should be sufficient to allow the head to be grasped even when arrested above the brim, without its being necessary to introduce the lock within the soft parts of the vulva, and so run the risk of pinching the mucous membrane. A length of about 9½ inches from the lock is sufficient for all cases. If the length is increased beyond this, the quality of stiffness is impaired without any corresponding advantage. The pelvic curve should not be greater than is necessary to allow the head to be grasped above the brim in the right direction. Any increase of

9½ FRO
LOC

curve beyond this renders the direction of traction more faulty. A curvature of not more than 35° in all is quite sufficient (see Fig. 216).

Varieties of long curved forceps. — A great variety of patterns of long curved forceps has been introduced. Of these the best known in this country are Simpson's forceps (Fig. 214), and Barnes'[*] (Fig. 215). Simpson's forceps have the most comfortable handles, the flanges below the lock (see Fig. 214) affording an excellent hold for the index and middle fingers. On the other hand they are scarcely long enough for all cases in which the head is high above the brim. Barnes' forceps have a more suitable length, though in some recent patterns the length is carried to excess. The two figures are drawn to the same scale and show the difference in length. The loop above the lock (see Fig. 215), is also a great advantage. It allows the left hand to grasp the forceps high up, the index finger being passed through the loop (see Fig. 222, p. 632). This is a gain, as will be seen hereafter, with a view to axis traction. The expansion of the shanks at this point also aids in guiding the blades into conjunction, as they are being locked. An excellent form of forceps is a combination of Simpson's handles with the blades and shanks of Barnes' forceps, including the loop above the lock for the insertion of the index finger (see Fig. 216). With this instrument, when two hands are used, the index finger of

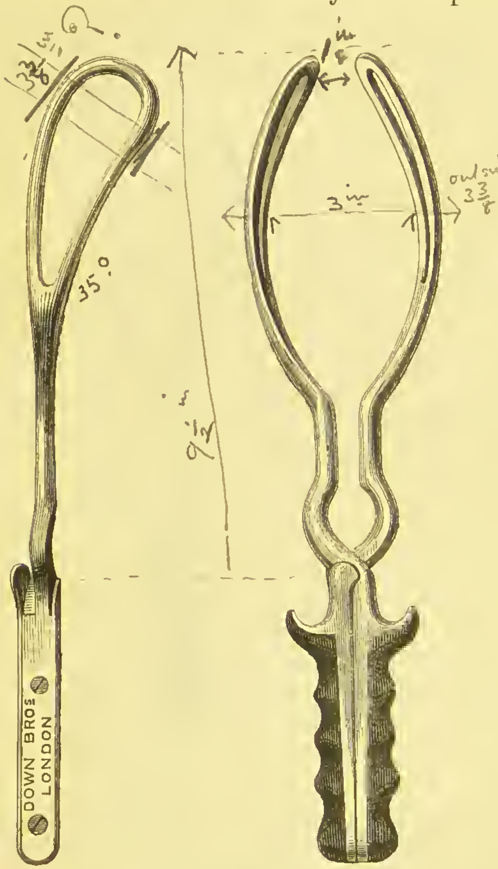

Fig. 216.—Long curved forceps. Pattern recommended by the author.

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[*] The pattern of these is similar to that of Lever's forceps, except that the handles are increased in length.

the left hand may be passed through the loop, or two fingers may be placed upon the flanges, according to circumstances. When one hand is used the index and middle fingers may be placed upon the flanges, and a firmer hold thus obtained than when the handles are merely grasped by their sides. The cross pattern on the wood, with which the handles of Barnes' forceps used to be made, with the idea that it makes the grasp more secure, should be avoided, since it only serves to abrade the hands, and afford lodgment for dirt. Most patterns of forceps are now made with metal handles, to allow them to be more easily rendered aseptic.

If the handles of the forceps are very short, the operator cannot compress the head firmly enough by grasping them to enable the blades to maintain their hold. If the hold on the head is maintained at all, when the resistance is considerable, it is because divergence of the blades at their widest parts is prevented by pressure against the pelvic wall. Some obstetric authorities have deliberately set themselves to design forceps with which the compression of the head shall be exercised by the pelvis, and not by the operator. Thus in Assalini's forceps, which at one time were used by many, the blades and handles are parallel and do not cross, so that practically no compression can be exercised by the handles. The straight forceps of Lazarewitch, with parallel blades, are made on the same principle. It seems obvious, however, that the pressure thus exercised on the pelvic walls by the wedge-like action of the diverging forceps-blades is entirely unnecessary and liable to be injurious. It is much better that the pelvis should be subjected only to so much pressure as is inevitable in the passage of the head, and that the compression should be exercised by the operator, who can then estimate what force he is exerting, and limit it to that amount which is necessary to maintain his grasp of the head. Forceps with parallel blades are also more difficult to adjust. Moreover, if the pelvis happens to be wide in its transverse diameter, although contracted in the conjugate, considerable divergence of the blades at their widest part will be allowed, and they are then liable to slip off the head. All forceps should therefore have crossing and not parallel blades, and the handles should be fairly long. Excessive compression of the head is best avoided by allowing an internal measurement of not less than three inches 3
between the blades at their widest part, when the handles are closed, and one of not much less than an inch between the tips of 1
the blades.

Disadvantages and advantages of straight forceps.—It has already been explained that, when the head is arrested at or above the brim, it is impossible with straight forceps of any length either to grasp the head, or to make traction, in the right axis, because the coccyx and perineum force the handles forward (see pp. 609, 610). In the high forceps operation, therefore, there is no question of the superiority of the long curved forceps over any form of straight forceps, and the statistics of the Rotunda Hospital, Dublin, already quoted (see p. 611), are sufficient to demonstrate this superiority. Moreover, since the pelvic axis is nearly straight for the first part of its course, there are many cases in which the head has entered the pelvic cavity, and which would be generally classed as cases of the low forceps operation, in which almost the same degree of disadvantage as to direction attends the use of straight forceps, because the proper direction of traction is still the axis of the brim (see Fig. 16, p. 18), and in which curved forceps have therefore the superiority. It is only after the centre of the head has passed the central plane of the pelvis, that straight forceps can grasp the head exactly in the right direction. When it has done so, the head will be already almost beginning to distend the perineum, especially if it has become much elongated by moulding, and by formation of the caput succedaneum (see Fig. 217, p. 619).

The only straight forceps much used in this country are the short straight forceps (Fig. 211, p. 610), in which the bow of the blades springs directly from the lock, without any straight portion of shank. These are adapted only for those cases of the low forceps operation in which the head is resting on the perineum, or its centre at any rate is below the central plane of the pelvis. But even in these cases, the wide expansion of the blades, springing directly from the lock, is apt to endanger the perineum (Fig. 217, p. 619), while, if the long curved forceps are used, the shanks lie further forward, out of the way. Moreover the greater facility of passing the blade of curved forceps, owing to its pelvic curve corresponding to the curve of the genital canal (see pp. 611, 612), is quite manifest even in low forceps operation. There is a further advantage in using the long-curved forceps for all cases, in that the operator is spared the necessity of carrying in his bag a pair of straight forceps in addition.

Straight forceps have, indeed, a few counterbalancing advantages. In the first place, when the head is near the outlet, the operator can make traction exactly in the axis of the plane of the pelvis in which the centre of the head is lying, by simply pulling in the line of the handles, whereas, with curved forceps, this can only be effected by a combined use of the two hands, as will hereafter be explained. In the second place, if it is desired to rotate the head, this can be done by merely rotating the handles on their own axis. With curved forceps, the head could only be rotated by turning the instrument round so that its pelvic curve is in the reverse direction of that of the genital canal, and it would then become more inconvenient than straight forceps.

Neither of these points, however, is often of much practical importance. As regards the first, when the head is passing the outlet, it is no great disadvantage to have the direction of traction inclined somewhat anteriorly as regards the pelvic axis. On the contrary, it may sometimes even be an advantage. For it is found that, in extraction by forceps, the risk of laceration is much greater to the perineum and posterior vaginal wall than to the anterior vaginal wall. Thus, vesico-vaginal fistulæ very rarely result from forceps delivery undertaken betimes, but much more frequently from labour having been left too long unassisted. Again, when the head is near the outlet, the natural expulsive force is inclined, in reference to

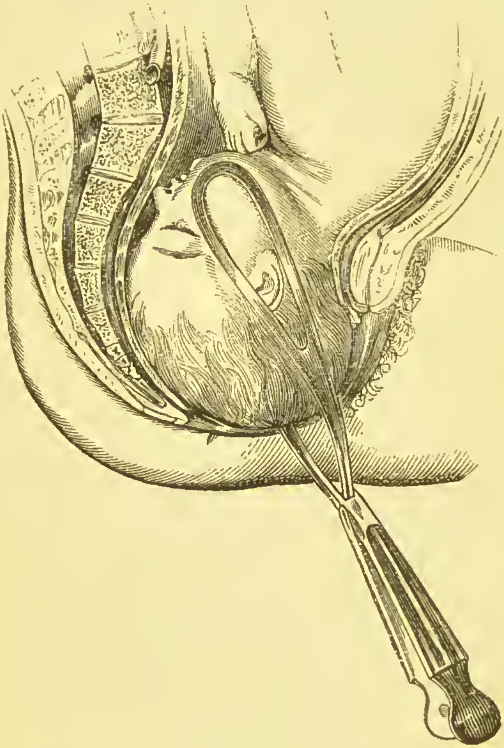

Fig. 217.—Short forceps applied to head in occipito-anterior position.

the pelvic axis, toward the *posterior* wall of the genital canal. If, therefore, traction is made in conjunction with the pains, its direction *ought* to be inclined somewhat anteriorly, that the resultant of the two forces may act nearly in the direction of the pelvic axis at the point where the centre of the head is lying (see Fig. 16, p. 18).

As regards the second point, it is not usually desirable, in occipito-posterior positions, to attempt to rotate the head actively with the forceps. The only condition in which such rotation is desirable is in face presentations, when the chin remains posterior (see pp. 241, 242) and extraction by forceps becomes necessary. This is the only instance in which straight forceps have a decided advantage over curved forceps, if the blades are applied to the sides of the face. Its occurrence, however, is so rare that it is hardly worth while for practitioners in general to carry straight forceps always with them, with a view to their use in this contingency. There are some cases, also, in which the head is arrested near the outlet and the usual internal rotation, bringing the occiput forward, has failed to take place. In these, straight forceps may be applied to the sides of the head, and so used as to assist the rotation of the long diameter of the head into the antero-posterior diameter of the pelvis. The same effect, however, may be produced by curved forceps, if these are applied diagonally as regards the pelvis, the upper blade being more anterior than the lower, if the head lies in the first or left occipito-anterior position. The blades will then grasp the head, if not exactly at the sides, yet with some approximation to this position; and, as the head rotates, the blades will be turned toward the sides of the pelvis, and the handles will turn forward. Moreover, by carefully sweeping the handles toward the front, a greater leverage for rotation of the head can be exercised by curved than by straight forceps. The only case, therefore, in which straight forceps have a decided advantage being one of such rare occurrence, it is better for practitioners in general to accustom themselves to use a single pair of forceps for all ordinary cases, both of the low and high forceps operation, and so learn to rely more upon their instrument and acquire greater dexterity in its use. It will be seen, however, hereafter that axis-traction forceps have a superiority in some difficult cases of the high forceps operation.

The pelvic curve should not amount to more than from 30° to 35° in all. If the curve is increased beyond the necessary amount, the deviation of the line of traction from the correct direction is increased, and then both the loss of power and the useless and injurious pressure on the anterior pelvic wall are increased more than in proportion to the deviation. In the forceps shown in Fig. 212

p. 610, the pelvic curve is too great, amounting to about 49° ; and the same is true of many foreign patterns of forceps.

Application of Forceps.

The indications for the use of forceps under various circumstances have been already discussed. Certain conditions are, however, necessary in all cases. These are that the membranes should be ruptured, that the os uteri should either be fully dilated, or at any rate sufficiently so to allow the blades to be passed through it without difficulty, and that a catheter should first be passed, to make sure that the bladder is emptied. The rectum should also be empty. The blades should be warmed to a comfortable temperature in hot water, lubricated with oil, and great care should be taken to make sure that they are perfectly clean and free from any septic material. To this end the instrument should not only be cleaned with scrupulous care after use, but immediately before use it should be immersed in a warm solution of carbolic acid, of a strength of at least 1 in 40, or disinfected by boiling.

Position of the Patient.—On the Continent, and in America, it is usual to place the patient in the lithotomy position at the edge of the bed ; in this country she is kept in the usual left lateral position, the hips being merely brought near to the edge of the bed, the knees drawn up toward the abdomen, and the head and shoulders directed toward the opposite side of the bed, so that the trunk lies transversely. The latter position involves much less disturbance of the patient, and has a great advantage in point of delicacy. It also allows the application of the forceps and the use of traction quite as well, and indeed better. For, with the lithotomy position, the hips must quite overhang the edge of the bed, otherwise there is not room sufficiently to depress the handles in the high forceps operation, and such a position may be difficult to maintain. The lithotomy position is more convenient only at the last stage of extraction, when the handles of the forceps have to be carried forward over the abdomen. Even this movement may be accomplished equally well with the lateral position if the knee is raised by the nurse or other assistant (see Fig. 223, p. 636). The mode of making axis-traction with ordinary forceps, to be hereafter described (see p. 626), is also much more difficult, if not impossible, to carry out, when the patient is in the dorsal position. The lateral position is, therefore, to be preferred. The application is easier if the hips are brought quite to the edge of the bed, because then there is plenty of room to depress the handle while passing the upper blade. This is not, however, essential, as will be seen hereafter, and, if the patient is nervous, it is possible to apply the forceps without changing her position.

Anæsthesia.—If the labour is being conducted without anæsthesia, there is an advantage in avoiding an anæsthetic for the application of forceps. For any anæsthetic diminishes the force of the pains which would otherwise act in conjunction with the tractile force. Moreover, for the application of the forceps the anæsthesia must be either short of the stage which completely abolishes self-control, or must be pushed nearly to the full surgical degree. An attempt to apply forceps in the stage of rigidity and spasm might cause injury. If the anæsthetic is to be given to the full surgical degree, there should of course, as in any other surgical operation, be a skilled administrator, who devotes himself to this duty alone. Generally, the application of the blades does not cause much pain in skilled hands. If, therefore, chloroform is being given during the labour, it may be continued during the application of the blades to the extent of deadening pain without quite abolishing self-control, and may be given to somewhat greater degree when traction is made. If Junker's inhaler is being used, the patient may be allowed to work the pump herself, since she will leave off working it before becoming deeply narcotised. If, however, the patient is very nervous and difficult to control, especially if she is a primipara in whom there is danger of the perineum being ruptured, there is a great advantage in having an assistant to administer the anæsthetic, and in having it given to a pretty full extent at the final stage of extraction, since otherwise a sudden movement at the height of a pain may render it impossible for the operator to prevent a rupture.

Introduction of blades.—In straight forceps the two blades are exactly alike, and it is therefore of no consequence which blade the operator takes up first. With curved forceps he must select the upper or lower blade. With the lock made as it usually is made, it is better, both with straight and curved forceps, to introduce the *lower* or left hand blade first. With curved forceps, if an inexperienced operator feels at first any doubt which blade is the lower and which is the upper, he should lock the blades together, and hold them in a position similar to that which they are to occupy when applied to the head, noticing that the concavity of the pelvic curve of the forceps must look forwards.

In the application of short straight forceps, most of the older authorities direct that the blades are to be applied to the sides of the head, towards whatever part of the pelvis these may look. Many have considered it essential that an ear should be felt, before the blades are introduced, that the exact position may be determined. The blades, however, pass so much more readily at the sides of the pelvis than in any other direction, that even those who endeavour to place them at the sides of the head are very liable, in point of fact, to apply them more in reference to the sides of the pelvis. Accordingly, it is now the usual plan, even if straight forceps are used, not to pay much regard to the position of the head, but apply the blades one at each side of the pelvis. In the case of the long curved forceps, it is generally taught that the blades should be applied at the sides of the pelvis, without regard to the position of the head.

The position of the head should, however, be exactly determined in the first instance, not so much that any great difference in the position of the blades should be aimed at in consequence, but rather that the operator may be made aware of any unusual position, such as a diagonal or nearly transverse position of the long diameter near the outlet, or an occipito-posterior position, which involves an increased risk of rupture of the perineum. The ear cannot generally be felt when the head is strongly flexed and much elongated without putting the patient to considerable pain. Feeling the ear, moreover, is quite unnecessary for the diagnosis of the exact position. This may be made out with certainty from the sutures and fontanelles, or from the sutures alone, if the fontanelle within reach is lost in the caput succedaneum (see p. 196).

In the directions which follow, it will be assumed that long curved forceps are used. The mode of introduction is, however, identical for short straight forceps, except that the handle of each blade has not to be held so far forward (see Fig. 218). Such forceps are of course not to be used unless the head is close to the outlet (as shown in Fig. 218).

When the head is close to the outlet and the usual rotation has taken place, the blades, if applied exactly at the sides of the pelvis, will grasp the head nearly at its sides, or in an only slightly diagonal position. The sides of the pelvis may in this case be followed exactly in adjusting the blades. If, however, the head is higher in the pelvis, and its long diameter diagonal, or if it has descended quite to the outlet, and the long diameter remains diagonal from failure of rotation, there is a slight advantage in attending somewhat to the position of the head in adjusting the forceps. Suppose, for instance, that the head lies in the first or left occipito-anterior position. Each blade may be passed up at the side of the pelvis, in the position in which it is found to glide up most readily. But, in adjusting the blades for locking, the upper blade may be brought slightly anterior to the middle line, and the lower blade slightly posterior (see Fig. 221, p. 627). This will cause the handles (of curved forceps) to incline somewhat downwards, or to the patient's left side. Then, as the head is drawn down in the grasp of the forceps, and the usual internal rotation takes place, the handles will first rotate to the front, and then probably somewhat over toward the right side. For the blades will have grasped the head somewhat diagonally, though not quite so much so as if they had been adjusted at first precisely at the sides of the pelvis. Similarly if the head lies in the second or right occipito-anterior position, the upper blade may be brought slightly *posterior* to the middle line in adjusting the forceps, . and the lower blade slightly anterior. If, however, any inexperienced operator feels any uncertainty in the diagnosis of the position of the head, or if it is obscured by the caput succedaneum, he may, without any disadvantage of consequence, regard only the sides of the pelvis in adjusting the blades.

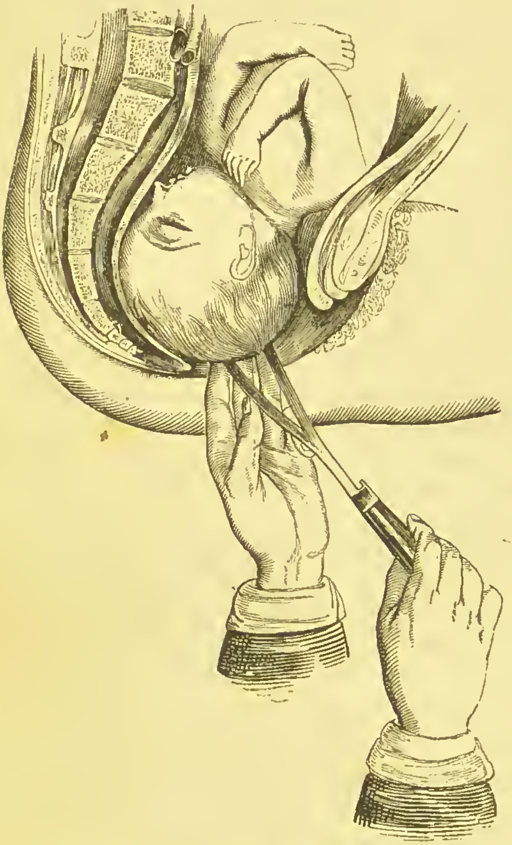

Fig. 218.—Introduction of the first or lower blade of short straight forceps. (After Tyler Smith.)

In the high forceps operation, when the head is at or above the brim, it is generally taught that the blades are to be applied at the sides of the pelvis, but some American authorities have advised that they should be applied at the sides of the head. Such a recommendation is not easy to carry out. For in the flattened pelvis the long diameter of the head is generally almost transverse, and the sacral promontory forms a great obstacle to passing the blade of the forceps over the side of the head which lies posteriorly. Moreover, if the blades could be applied anteriorly and posteriorly, or nearly so, the advantage of the pelvic curve of the forceps would be lost, and this curve would become an absolute inconvenience, being directed toward the lateral pelvic wall.

The best plan is to follow the same rule as when the head is lower down in the cavity, *provided that the long diameter of the head lies obliquely*, namely, so far as possible to adjust the blade corresponding to the anterior side of the head somewhat anterior to the middle line, and the other somewhat posterior. The head will then not be quite so much bulged out in the diameter engaged in the conjugate diameter of the pelvis, as if the blades were exactly lateral, and, as the head descends in the pelvis, the pelvic curve of the forceps will be more nearly in accordance with that of the genital canal, after the internal rotation of the head has taken place.

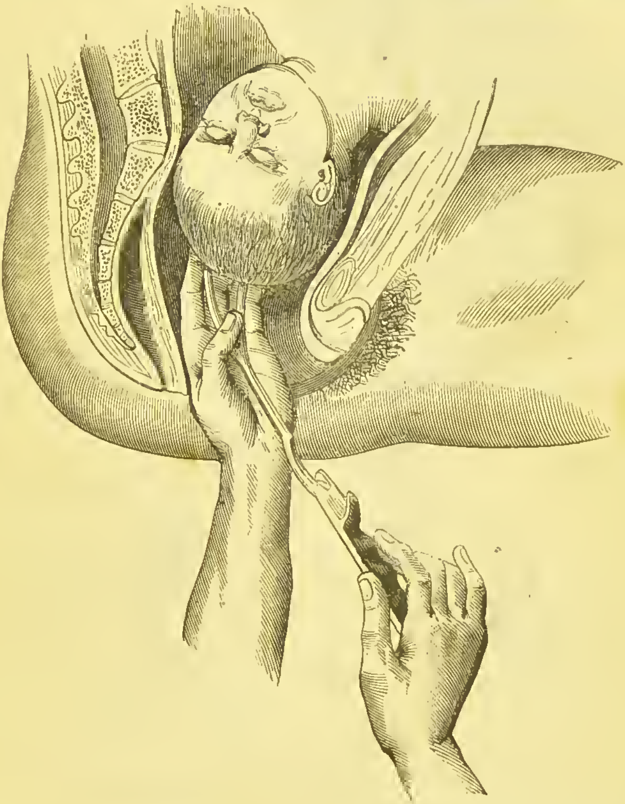

Fig. 219.—Introduction of first or lower blade of long curved forceps.

When, however, the pelvis is so decidedly flattened that the long diameter of the head lies almost exactly transversely, it is better to adjust one blade over the forehead, and the other over the occiput, that is to say, to place the blades at the sides of the pelvis. The pressure of the forceps will then not be so likely to displace the long diameter of the head out of the most favourable position as it would be if the blades caught the head obliquely. The head will probably be drawn through the contracted brim in its original transverse position. After the head has passed the brim, and internal rotation commences, the forceps may be taken off and reapplied, or they may be loosened sufficiently to allow the head to rotate within the blades under the influence of the pelvic pressure.

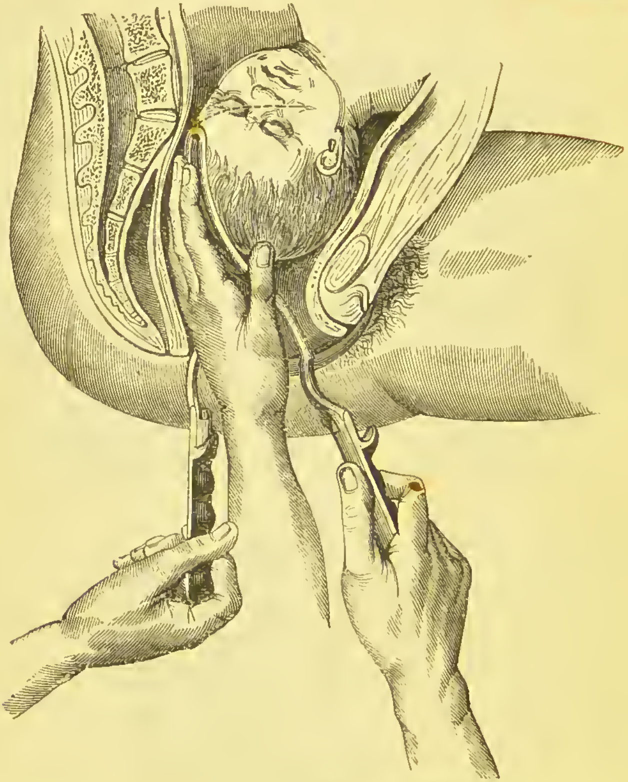

Fig. 220.—Introduction of second or upper blade of long curved forceps. The dotted line indicates the path of the tip of the blade over the head, as the blade is brought into its final position, somewhat anterior to the right side of the pelvis (the head being in the first position.)

Introduction of lower blade.—The operator sits at the bed-side, opposite the patient's hips. The left hand or half-hand is introduced into the vagina, the back of the hand directed towards the patient's left side. If the margin of the cervix can still be felt, the tips of the fingers are placed upon the head just within the cervix, so as to make sure that the blade of the forceps passes within the cervix and not outside it. If the cervix has retracted quite out of reach, the passage of the blade in the right direction is easily secured, simply by keeping the tip of the blade in close contact with the head. The lower blade of the forceps, warmed and oiled, is taken in the right hand, and the end of the handle held very lightly between the tips of the thumb and two or three fingers. The blade is guided up along the flexor surface of the hand till the point of the blade rests on the head, just under the tips of the fingers (see Fig. 219, p. 625). The handle is at first somewhat raised and directed rather forward, so as to allow the tip of the blade to lead the way along the curve of the genital canal. As the blade passes up, the handle is carried somewhat backward. As soon as the tip of the blade rests on the head, the curvature of the blade must be made to correspond with that of the head, to secure easy progress; for if the tip of the blade impinges upon the head at an angle, it will push the skin of the head up in a fold, and will be thereby arrested. For this purpose it is generally necessary to raise the handle somewhat further. In pushing on the blade into position over the head, the essential point is to hold the handle very lightly, and overcome any resistance by change of direction, and not by the use of force. As the blade passes on, the handle is lowered and carried backward, until the shank rests against the perineum. The flat inner surface of the handle should look nearly downwards (see Fig. 219). The

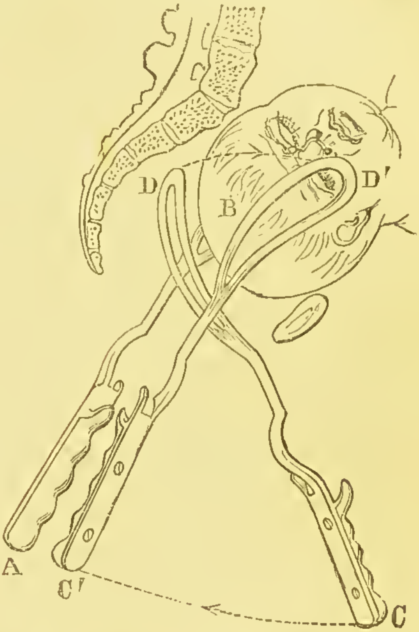

Fig. 221.—Diagram to illustrate introduction of second or upper blade of long curved forceps, the head being in the first position. A B, lower blade already introduced, adjusted somewhat posterior to the left side of the pelvis. C D, position of upper blade as it approaches the head. C′ D′, its final position just before locking, adjusted somewhat anterior to right side of pelvis. C C′, D D′, paths of end of handle and tip of blade. The flat internal surface of the handle looks at first backwards and slightly upwards, finally upwards and slightly forwards, in consequence of the rotation of the blade.

easy passage of the blade in this manner is a proof that it is going in the right direction.

The lower blade having been passed, the handle should be given to the nurse or other assistant, who is to hold it firmly enough to prevent its rotating, keeping it backward against the perineum (Fig. 220, p. 626). If no assistant is available, the handle may be allowed to rest on the back of the left wrist, while the left hand is passed into the vagina to guide the upper blade into position. It is always preferable, however, to have an assistant, to hold the handle, if possible.

Introduction of upper blade.—If the patient's hips are completely overhanging the edge of the bed, the upper blade may be placed in exactly the same way as the lower, the handle being depressed instead of raised. Frequently, however, the edge of the bed interferes somewhat with the handle being fully depressed. Introduction is then facilitated by the plan of carrying the handle at first far forward close beneath the patient's left thigh, instead of depressing it so much. The effect of this is that the blade passes at first not up the side of the pelvis, but nearly opposite the right sacro-iliac synchondrosis, a direction in which there is generally more free space than in any other (Fig. 220). When it has passed up to the required level, it is brought round into position over the head at the side of the pelvis, or somewhat anterior to the middle line if the head is lying in the first position, by carrying the handle backward and slightly depressing and rotating it. Thus, as this blade passes up, the inner flat surface of the handle looks at first nearly backwards, but eventually upwards, or upwards and somewhat forwards (see Fig. 221). To guide the blade within the cervix, the left hand is passed into the vagina in the same way as for the lower blade, the back of the hand being directed to the patient's right side, and somewhat backward (Fig. 220, p. 626).

Locking the blades.—The blades having been passed in this way, the lock will be found in the right position for adjustment. For locking, the blades must be passed to the same level, and the flat surfaces of the handles, and therefore also the blades, must be exactly opposite each other. If one handle is found to project more outside the vulva than the other, it must be passed in a little further, or the other slightly withdrawn, until the two are exactly equal. It happens, not unfrequently, that both blades tend to turn somewhat backward into the spaces opposite the sacro-iliac synchondroses, where is more room for them than at any other part of the pelvis. This tendency is increased if there is a long rigid perineum, which pushes the handles forward, and thereby tilts the upper part of the blades backward. If the forceps cannot be locked, from the handles not being opposite to each other, this rotation of the blades will be found most frequently to be the cause of difficulty; for the effect of it is that the flat interior surfaces of both handles are inclined forward, instead of being exactly opposite to each other. To overcome the difficulty, the lower handle should be taken in the right hand and the upper handle in the left, and both handles pressed backward toward the perineum. This will bring the upper part of the blades forward over the head to the sides of the pelvis. At the same time, both handles are to be rotated in opposite directions until the flat surfaces exactly face each other, and the forceps will then at once lock. In making this adjustment, as has already been mentioned, it is a good plan, when the long diameter of the head is diagonal, to bring the blade corresponding to the anterior side of the head in front of the middle line, and the other behind it. The upper blade will then be somewhat anterior, when the head is in the first position, the lower blade, when the head is in the second position. If the handles can be easily brought together, or nearly brought together after locking, it is a sign that the blades are rightly adjusted within the uterus. As the blades are locked, if the lock is near to the vulva, care must be taken that no mucous membrane or hair is caught in it.

When the forceps are locked, the fingers should be introduced to make sure that the blades are properly applied to the head and within the os uteri. Not more than about one-third of the fenestræ of the blades should be felt lying free below the head. If the head is very large and much elongated, nearly the whole of the fenestræ may be in contact with the head. If, when traction is made, a greater and greater proportion of the fenestræ can be felt below the head, this will indicate that the blades are slipping off.

There is generally a groove round the handles of the forceps, to enable the handles to be tied together. Tying the handles, is however, quite unnecessary. If they are held lightly in the intervals of traction, the forceps will not become unlocked; and it is important that, in these intervals, the head should be entirely relieved from the pressure of the blades. If, therefore, the operator should desire to tie the handles together, in order to be able entirely to let them go, they should be tied only quite loosely, sufficiently to prevent their becoming unlocked, but not to cause any pressure upon the head.

If the handles are found completely to close together with moderate pressure, it is a sign that the head is small, and is not grasped in one of its long diameters. If, on the other hand, they remain considerably apart, it may be inferred that the head is large, or is seized in one of its long diameters. If the separation of the handles is *very* great, a hydrocephalic head may be suspected.

Mode of making traction.—If the pains are still normal in character, traction should be made only during the pains, so that the artificial help may be combined with the natural force. The only exception to this is the case in which, at the final stage of extraction, there is danger of the perineum being ruptured, especially when the patient is a primipara, and difficult to control. It is then often better to extract the head in the *interval* of pains, so that the exact degree of force may be regulated, and may not be liable to be disturbed by a sudden expulsive effort. If the pains have become ineffective, and occur only at long intervals, or if the uterus has passed into a state of continuous action, traction should be made at intervals corresponding to those of the natural pains; for discontinuous pressure is less likely to be injurious, both to mother and child, than continuous pressure, the circulation being restored in the intervals of rest. The handles should be compressed during traction, and the compression should be proportional to the tractile force exerted, so that a firm hold may be maintained on the head. In the intervals of traction, the compression should be taken off.

Resistance of cervix.—In those cases in which forceps are applied with a cervix not yet fully dilated, before any effort is made at extraction, the operator should ascertain whether the resistance to the advance of the head is due, in part or in whole, to the cervix. For this purpose moderate traction may be made on the handles with the right hand, while the left hand is passed into the vagina to feel whether the effect of this traction is to put the cervix on the stretch, and to what extent. In general, if the cervix is the cause of difficulty, it will be the external os which forms the obstacle. In some cases, however, especially when labour has been brought on rapidly in consequence of some condition dangerous to the mother, such as eclampsia, the internal os will be found to be not fully dilated, and to be forming a rigid barrier. If the obstruction is due to incomplete dilatation of the cervix, much longer time must be allowed for delivery with the forceps, often as much as an hour or even two hours. Otherwise the cervix is likely to be lacerated, and then there is an increased risk of septic absorption and pelvic cellulitis, as well as of subsequent chronic uterine disease set up by the ununited laceration and consequent eversion of the cervix. In order to bring about gradual dilatation of the cervix the traction must be gentler and more continuous than when the obstruction is due to the pelvis, and the finger should be frequently, if not constantly, testing the degree of strain which is placed upon the tissues. In some cases of contraction of the brim the cervix is not fully dilated because the head is arrested above the brim, and not able to descend upon it and complete the dilatation after the escape of the liquor amnii. It may then be necessary to make powerful traction at first, to cause the head to enter the pelvis and descend upon the cervix, and then, when this stage has been reached, to be very gentle, and allow ample time for the cervix gradually to yield.

When no part of the resistance is due to the cervix, extraction may be made more rapidly, especially if the perineum also forms no obstacle. But in all cases of forceps delivery there should be no hurry, and time should be allowed for moulding of the head. The time required for extraction in such cases may vary from a few minutes to half an hour or more, according to the resistance encountered.

Direction of traction.—The object is in general to make traction in the direction of that part of the pelvic axis (see Fig. 16, p. 18), in which the centre of the head lies. This is the direction in which, if the forceps are correctly applied, the head is grasped by the upper portions of the blades, that is to say, by those portions which alone communicate to it the onward impulse (see Fig. 222, p. 632). In a normally shaped pelvis it must be remembered that the direction of the axis is practically straight as far as the central plane of the pelvis, and that it is inclined at an angle of 55° or 60°, nearly two-thirds of a right angle, to the axis of the woman's body. Traction has therefore to be made as nearly as possible in the axis of the brim, downward and backward, with any position of the head, from one quite above the brim to one in which the advanced part of the head is beginning to press upon the inclined perineal body or pelvic floor, the centre of the head having reached the central plane of the pelvis. From this point onward the direction of traction must be carried rather rapidly forward, until at the outlet, if the perineum was previously intact, the direction has been changed through an angle of as much as 135°, and is now almost horizontally forward, in reference to the axis of the mother, the handles of the forceps being carried up over the abdomen. (See Fig. 16, p. 18, and Fig. 223, p. 636.)

Direction of traction in flattened pelves.—In flattened pelves there is often posterior obliquity of the uterus in reference to the axis of the brim, especially if the pelvic inclination is increased. Regard must then be paid to the "curve of the false promontory." If the head is lying loose, high above the brim, when the forceps are applied over it, the centre of the head may lie behind the axis of the brim, the head being held back by the anterior uterine wall, in consequence of the posterior obliquity of the uterus. Traction must then be made at first a little more forward than the axis of the brim, in order to get the head to enter the brim. A little later, when the centre of the head is passing the brim and rounding the promontory of the sacrum, the backward inclination of the traction should be somewhat increased, so as to bring the head into the hollow of the sacrum. Then, as in the ordinary case, the traction should be continued in nearly the same direction till the advanced part of the head begins to press upon the pelvic floor, and afterwards shifted rather rapidly forwards.

When, however, the uterus is active, and the head is pressed down upon the brim, the centre of the head will generally lie, if anything *anterior* to the axis of the brim from the first: for the uterine force presses the head downward and forward in reference to the axis of the brim, and the last lumbar vertebra pushes it forward somewhat over the edge of the brim, if it is too large readily to enter. Any Naegele-obliquity which may exist (see pp. 528–530) will also bring the centre of the head more forward. In this case the traction must from the first be directed well backward, somewhat more posteriorly than the axis of the brim.

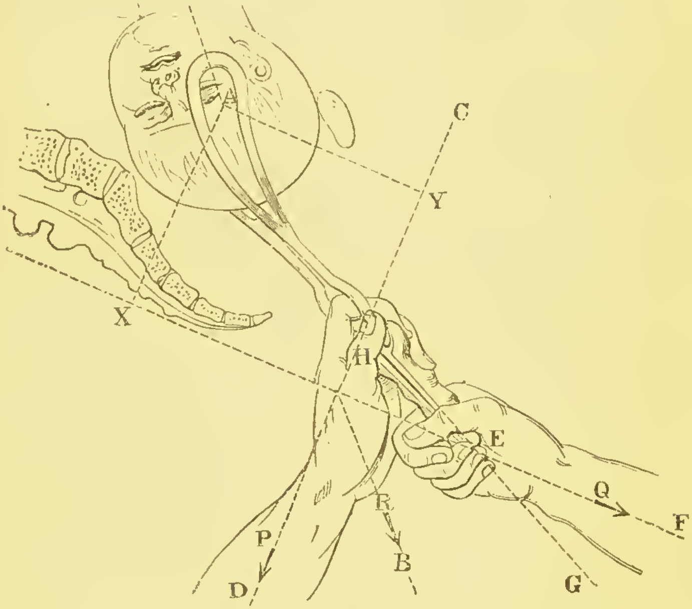

Fig. 222.—Mode of making axis traction with ordinary long curved forceps. A, centre of head, as grasped by the forceps. P, Q, forces exerted by the two hands. H D, E F, directions of forces, P, Q. A X, A Y, perpendiculars from A upon E F, H D. A R, axis of brim. R, resultant of P Q.

Axis traction.—The only way in which, with long curved forceps, it is possible to exercise traction accurately in the direction of the pelvic axis at the brim or at any other point, and, at the same time, in the direction of the upper halves of the blades, is to grasp the handles with two hands. The mode in which traction can, in this way, be made in the axis of the brim, assuming that an equal tractile force is put out by the two hands, is illustrated in Fig. 222, p. 632. The forceps are held by the right hand at the extremity of the handles, and by the left hand near the lock, the forefinger being passed through the loop above it. The mechanical conditions necessary to secure the required result are two. First the product of the force P exercised by the left hand and the perpendicular A Y from the centre of the head upon its direction must be equal to the product of Q, the force exercised by the right hand and the corresponding perpendicular A X upon its direction. The operator need not, however, trouble himself about this condition, for, in order to fulfil it, he has only so to pull that the handles are not carried either forward or backward.

The second condition is not quite so easy to fulfil exactly. It is that the lines of traction with the two hands must be equally inclined to the axis of the brim. The two lines of traction (X F, Y D, Fig. 222) will then meet upon the axis of the brim A B, and the direction of R, the resultant of the two forces, will coincide with the axis of the brim. It will be seen by the figure that the inclination of the two forces to each other ought to be about a right angle, with forceps of the ordinary shape and length, assuming that the two hands pull with equal force.[*]

The following is then the rule for exercising axis-traction with ordinary forceps. Grasp the forceps in the way shown in the figure. Let the right forearm be inclined slightly forwards (at an angle of about 15°) in reference to the handles of the forceps, and the left forearm be about at right angles to the right. Then pull with each hand, not directly forward to the chest, but in the line of the corresponding forearm, and let both hands pull with equal strength.

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[*] The conditions are that P × A Y = Q × A X, and that Y D, X F, the direction of the forces P, Q, are equally inclined to the axis of the brim. Also P = Q, if the two hands pull with equal force. Therefore A Y = A X, since P × A Y = Q × A X. The force P acting at H is equivalent to a force P acting at A in a parallel direction together with a couple P × A Y. The force Q acting at E is equivalent to a force Q acting at A in a parallel direction together with a couple Q × A X. Adding the two together, the couples cancel each other, since they are equal and act in opposite directions. Hence the forces P and Q acting on the handles are equivalent to equal and parallel forces P and Q acting at A, the centre of the head. Since these are equal and equally inclined to the axis of the brim, their resultant R must act along A B, the axis of the brim. Hence the original forces P and Q acting on the handles are equivalent to a single resultant R acting at the centre of the head, and in the axis of the brim. It follows that Y D and X F must meet on A B, the axis of the brim, since the resultant of the two original forces must pass through their point of intersection.

The forearms will naturally be in the position above described, namely, about at right angles to each other, if the elbows are kept near the sides. The inclination of the two arms to the forceps is also that at which the hands can most easily and naturally grasp them. In order, therefore, to make axis-traction with ordinary forceps, the operator has not to make any careful estimate of angles. He has only to take hold of the forceps in the right way, and hold them in the most natural manner, keeping his elbows near his sides, and merely to remember that the traction of each hand ought not to be directly toward the chest, but in the line of the corresponding forearm.

It is obvious that for axis-traction exercised in this way Barnes' forceps have an advantage over Simpson's, since the loop above the lock in the former gives a convenient hold for the left hand at a greater distance from the end of the handles than the flanges of Simpson's forceps. With the forceps shown in the figure (see also Fig. 216, p. 616) the finger should be passed through the loop, not rested on the flanges, if axis-traction is desired.

The case given above is the most simple one. If the hands pull with unequal strength, the desired result may be attained in many different ways. Thus, if the left hand pulls more strongly than the right, or if the left hand grasps the forceps higher up the shanks, the proper direction of traction for the left hand is not directed so much backward, and the two directions of traction need not diverge by so great an angle as a right angle.

By this method it is possible, with ordinary forceps, to secure axis-traction with considerable approximation, if not with absolute exactitude ; and a slight deviation from the true direction is not of much consequence. Suppose, for instance, that the deviation is 10° ; then the amount of force lost as regards the advance of the head is only about one fiftieth of the whole, and the unnecessary pressure on the pelvic wall about one thirty-sixth of the force employed.

The mode in which the use of two hands enables the traction to be made more backward than it otherwise could be may be explained by saying that the two blades of the forceps, united in one mass with the head, form a lever, the fulcrum being the point grasped by the left hand and fixed by the traction of that hand. The traction of the right hand, applied at the end of the handles and inclined forwards, therefore tends to tilt the centre of the head, at the opposite end of the lever, backwards.

In all cases in which the head lies at or above the brim or at some height in the cavity of the pelvis it is desirable to adopt the plan of traction with two hands which has been here described ; for even if the operator does not trouble himself about judging exactly the correct position of the arms, the resultant force is likely to be more nearly in the right direction than if traction were made simply from the centre of the head to the lock or end of the handles. If resistance is slight, there is no harm in drawing with the right hand only, two fingers being placed over the flanges, or one finger through the loop above the lock, and this method allows the left hand to be passed into the vagina in order to feel the tension of the cervix, or judge whether the blades are keeping in position ; for the pressure on the anterior pelvic wall so produced is not then likely to be great enough to do any mischief.

Traction to be steady, not oscillatory.—As a rule traction should be steady in the direction judged to be the right one, without any swaying of the handles of the forceps, although such a "pendulum movement" has been recommended by many authorities. The exceptional cases in which an exertion of leverage by oscillatory movement of the handles is admissible will be considered hereafter. If, however, the head is found not to advance, it is desirable somewhat to vary the direction of traction in a tentative way, to see if some direction may not be found in which traction is more effective ; for the operator may not have been quite accurate in his judgment of the direction of the pelvic axis at the point where the centre of the head is lying, or there may be some peculiarity of the pelvis which he has not been able to discover.

Amount of force to be exerted.—Experience alone can enable the practitioner to judge accurately the amount of force which may be exerted with safety to the mother, and the time during which it may safely be prolonged. It is to be remembered that the use of forceps, as compared with craniotomy in a doubtful case, is an operation for the interest of the child, and that it is not justifiable seriously to endanger the mother, in order to save the child. In a difficult case, the operator may find it necessary to get counter-pressure by placing his knees or feet against the edge of the bed, and having an assistant to press against the patient's buttocks, in order to keep her in position. A person not of great muscular power may sometimes have to put out as much tractile force as he can exert in a steady manner. Cases are sometimes recorded, especially abroad, in which two persons have combined their strength in pulling the handles. This is probably never safe for the patient. Even a strong man should be cautious about putting out his full strength, and may with advantage practise with a dynamometer, so as to learn to be able to estimate the amount of force which he is exerting. The amount of force which may be used legitimately with forceps has been estimated as considerably exceeding 100 lbs. ; but there has never been any satisfactory determination of the limit of force which is really safe for the mother.

Mode of traction at the vaginal outlet.—When the head begins to distend the perineal body, or inclined plane of soft parts forming the pelvic floor (see Fig. 88, p. 183), the mode of traction should be altered. The resistance is now due to the soft parts, and has to be overcome rather by gradual extension than by great force, in order to avoid laceration as far as possible. The right hand alone may now be used for traction, while the left hand is used to estimate the tension placed upon the vaginal outlet, or to shield the perineum by pressure exercised in front of the sacro-sciatic ligaments, in the manner recommended for cases of ordinary labour (see p. 215), and shown in figure 223. The inclination of the tractile force forward in reference to the axis of the genital canal is not now a disadvantage, since it is chiefly the posterior wall of the genital canal which is in danger of laceration, and the natural expulsive force is itself inclined backward toward that posterior

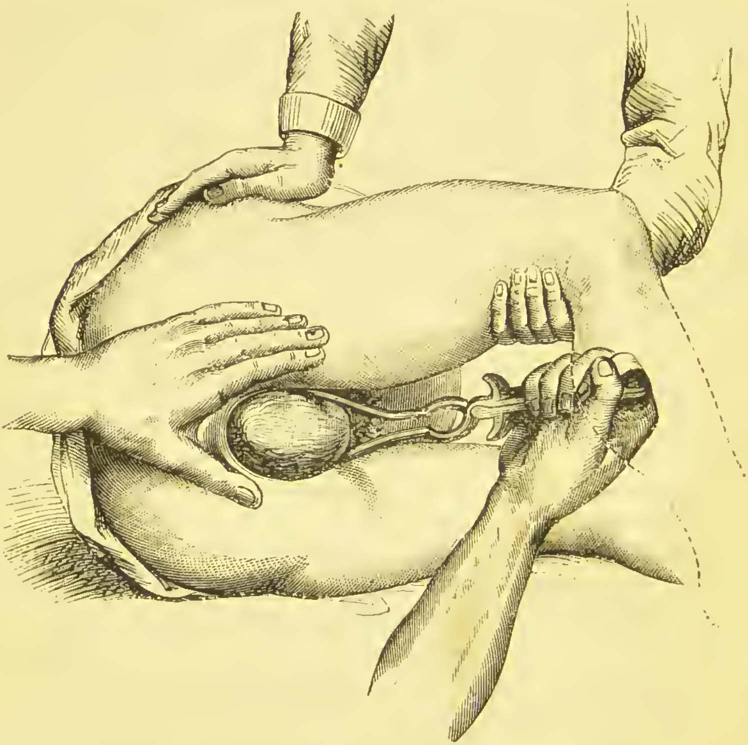

Fig. 223.—Mode of delivering head through vulval outlet.

wall. In primiparæ, and in all cases where laceration of the perineum appears to be threatened, much time should be allowed at this stage, and the vaginal outlet should be very gradually stretched, in imitation of nature, by successive efforts, with intervals between them. If the uterus is acting vigorously, traction with the forceps should not be made with the pains, but only in the intervals. During the pains the too rapid advance of the head should be checked, partly, as in natural labour, by pressure upon it with the left hand, partly by actually resisting it with the forceps, the handles being pressed rather back instead of carried forward.

Grasp of right hand to be shifted.—As the head first begins to approach the outlet, traction may be made by the right hand grasping the handles in the usual way, two fingers being rested on the flanges, or one finger passed through the loop above the lock. The handles have now to be swept rather rapidly forward, and eventually carried up somewhat in front of the abdomen. To allow this the patient's leg should be held up by the nurse or other assistant (Fig. 223, p. 636). At the stage when the occiput is beginning to emerge at the vulva, the grasp of the right hand should be shifted, so that the palm of the hand is transferred from the anterior to the posterior surface of the handles, and the hand is now used to push rather than to pull, in the position shown in Fig. 223, the left hand being spread out in front of the sacro-sciatic ligaments, to keep the head forward, and so relieve the strain on the perineum. Not much force can thus be exercised, but only a very little is wanted. The final emergence of the head should be managed with extreme slowness, the tension of the edge of the perineum being estimated by the left hand. It should be remembered that the maximum tension is reached just at the moment when the forehead is passing the perineal margin.

Removal of blades.—As soon as the chin is clear of the perineum the blades are easily removed. In some cases, when it is not the resistance of the perineum which has required the application of forceps, but some obstacle at a higher lever, and when there appears to be danger of laceration, the uterus acting vigorously, it is desirable to unlock and remove the blades before the head has passed the vulva, that the tension may not be increased even by the small amount of space which the blades themselves occupy.

The leverage action of forceps.—When the head is tightly grasped by the forceps, so that the head and two blades form one solid mass, and an oscillatory or pendulum movement is made with the handles, a kind of leverage may be exercised which aids the advance of the head. In order to understand the mode in which the lever is formed three points must be borne in mind.* First, a lever need not be a straight bar, but may be bent at a right angle, or may be of any shape whatever. Secondly, the directions of action of the power and the weight or resistance need not be parallel, but may be inclined at any angle. Thirdly, the fulcrum need not be an absolutely fixed axis, but only one which is fixed for the moment by the action of the forces which are at work.

Suppose, now, that the head is engaged in the pelvic cavity, and gripped tightly by the blades, while the handles are swayed toward the posterior pelvic wall at the same moment that traction is made. One of three things may then happen :—

(1.) The posterior side of the head may be fixed against the pelvic wall by the combined effect of traction and the friction which prevents its receding, while the anterior side of the head descends, and the centre of the head therefore necessarily advances. The head with the forceps then virtually forms a lever bent nearly at right angles. The fulcrum is at the posterior pelvic wall. The resistance acts upwards along the pelvic axis, not far from the centre of the head. The power acts at the end of the handles downward, and only slightly backwards, but only that part of it which tends to rotate the whole mass about the fulcrum exercises a leverage action. The mechanical advantage of the lever is measured by the ratio of the distance between the end of the handles and the fulcrum to the distance between the point near the centre of the head where the resistance acts and the fulcrum. With ordinary long forceps the former will be about 11 inches, the latter probably about 2 inches. Hence the component of the power which pushes the handles backward produces a force at least five times its own magnitude, causing advance of the head.†

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* For a fuller discussion of the question, see a paper by the author, "On the Action of Midwifery Forceps as a lever," Obstet. Journ., Vol. IV., 1877.

† In many descriptions in obstetric works there has been hopeless confusion between this kind of leverage and the double leverage of forceps as a compressor, previously described, in which the fulcrum is at the lock. Thus Tyler Smith says ("Manual of Obstetrics," p. 585), "Besides the efforts of traction, the handles should be moved a little from side to side in extracting, so as to use each blade in succession as a lever." Barnes says ("Lectures on Obstetric Operations," 2nd Ed., p. 28), "When the blades are crossed and locked, the common fulcrum is at the lock. Then by gentle bearing upon either handle alternately, swaying the instrument backwards and forwards, avoiding all pressure against the pelvic walls, you cause the head-globe to rotate to a small extent alternately in opposite directions upon its own centre. At each partial rotation a little descent is gained, owing to the point opposite to the lever in action being partially fixed by the other blade; and by gentle traction upon the handles." Leishman says ("System of Midwifery," 3rd Ed., p. 541), "The forceps, as almost invariably constructed with the English or other similar lock, is composed of two levers, the fulcrum of each being the lock. This enables us, by a swaying movement of the hands, to apply extracting force, partly by leverage and partly by traction, to each side of the head successively, without the danger which attaches to the single lever or vectis, where it is necessary to find a fulcrum in some part of the pelvic wall."

(2.) The posterior side of the head may slip back somewhat, but not so much as the anterior side of the head descends. In this case the fulcrum is an axis intermediate between the centre of the head and its posterior side, and it is fixed, as the posterior side was in the former case, partly in consequence of the friction, which resists the slipping back of that side, and partly by the traction.

(3.) The posterior side of the head may slip back as much as the anterior side descends. In this case there is no leverage tending to aid extraction, no advance of the centre of the head, and the oscillatory movement is useless.

Whenever the oscillatory movement is made, the head remaining fixed in the grasp of the blades, the friction over a part of the head is reversed in direction, since it is made to resist a slipping back instead of an advance. Hence the force required to produce advance is less than that which would be necessary with direct traction only by twice the magnitude of the friction which is so reversed, for the reversed friction, instead of opposing the tractile force, now assists it by neutralising an equal amount of friction at the other side of the head. Under the most favourable conditions possible the amount of friction reversed might be nearly one half of the whole. In this case nearly the whole of the resistance due to friction might be done away with by the use of the oscillatory movement with the handles.

This consideration, that the gain which can be obtained is due solely to the amount of friction which can be reversed, indicates the cases in which an oscillatory movement is admissible: they are only those in which friction is an important obstacle to advance. When the head is resisted by a brim which it has not yet entered, or by a vaginal outlet or perineum not yet stretched enough to allow it to pass, and in all cases in which the head is moveable, and can be pushed back easily in the interval of pains, the oscillatory movement fails to bring any mechanical advantage. It is also better to avoid it whenever the object can be attained by direct traction of moderate degree, on account of the injury to soft parts which may possibly be caused by the attempt to carry it out.

When, however, the head is engaged in the pelvic canal, and impacted in it by friction so that it cannot readily be pushed back in the interval of a pain, and when moderate direct traction fails to cause any advance of the head, oscillatory movement of the handles may be cautiously tried before recourse is had to craniotomy. The oscillation should be limited in degree, and with each oscillation should be combined firm compression of the handles, so as to make the head one solid mass with the blades, and the maximum of traction which it is thought safe to exert. The oscillation, to be of service, should also be in that diameter in which the head is most tightly gripped by the pelvis. Thus in a flattened pelvis it should be backward and forward, in a uniformly contracted pelvis it may be in both directions, or the two may be combined in a limited circular movement. Side-to-side movement, in a flattened pelvis, is entirely useless, and only likely to be injurious. The oscillatory movement should not be persevered with long, unless the head is found to advance with it, for, if the leverage is successfully called into play, there must be an advance at each oscillation.

The mechanism by which this movement causes advance is analogous to that by which a cork is got out of a bottle by pushing it from side to side, and also to that by which a tight ring is removed from a finger by pulling first one side and then the other instead of pulling the two sides together. Both these instances show that by leverage advance can be effected by less force than would otherwise be necessary. Moreover, the shape of a cork, a long cylinder, is much more unfavourable for such leverage than than of an ovoid body like the fœtal head.

The operator may fail in his effort to exert leverage in two ways. (1.) The blades may slip backward and forward over the head, instead of holding it as one solid mass with themselves. The head is then likely to be injured by the friction. (2.) The head may simply sway backward and forward on its central axis, instead of advancing. The friction is then most likely to do damage to the maternal soft parts.

There is another way in which a very slight oscillatory movement may be of advantage when the head is impacted in the pelvic canal by friction. This depends upon the fact that statical friction, or friction between bodies at rest, is always greater than dynamical friction, or friction between bodies in motion, especially when the bodies have been long in contact. When friction is a main element of the resistance, a slight oscillatory movement of the head may convert the statical friction into the lesser dynamical friction over the greater part of its surface. For this purpose the slightest possible oscillation of the handles is sufficient, provided that the head is held tightly enough to take part in it.

Reason for applying the lower blade first.—It has been recommended that the lower blade of the forceps should be introduced first, although some authorities give the contrary advice. The reason for choosing the lower blade, with forceps made in the usual way, depends upon the construction of the lock. On referring to Fig. 220 (p. 626), it will be seen that, if the lower blade is introduced first, and the handle held backward, then the handle of the second blade passes in anterior to that of the first, and the two handles are at once in the right position for locking. If the upper blade had been introduced first, and the handle held backward, then the handles would have been in the wrong position, and the lock could not have been adjusted without reversing the relative position of the shanks. Some authorities teach that the upper blade should be introduced first, and the handle held *forward*, while the second blade is being introduced, the assistant standing, not behind the patient's back, but in front of her knees. The second blade is then passed up behind the handle of the first, and the handles come into the right position for locking. The objection to this is that, when the handle is held forward, the blade is only half applied over the head—in the high forceps operation scarcely so much as half applied—and is therefore more liable to become displaced. It is also impossible to dispense with an assistant for holding the first handle. This may be managed, as already described (see p. 628), when the lower blade is introduced first, by resting the first handle on the back of the wrist. If, therefore, it is desired to introduce the upper blade first, it is better to have the lock of the forceps made in the reverse way to the ordinary one. The upper blade can then be passed first, and the handle held backward while the second blade is introduced.

The lock of the forceps can, of course, be made equally well either way. Assuming that the forceps have yet to be constructed, there are some advantages each way to be considered in deciding whether the lock should be fitted for the introduction of the lower or of the upper blade first. If the lower blade is passed first it is not so likely to get out of place from the effect of gravity as the upper blade would be, while the second blade is being introduced. On the other hand, the upper blade is the more difficult to introduce. There is, therefore, a certain advantage in introducing the upper blade first, while the difficulty is not increased by the vagina being already occupied, to some extent, by the first blade. Individually, I prefer, on the whole, the introduction of the upper blade first, and have therefore had the lock of my axis-traction forceps (Fig. 228, p. 646) made in the reverse way to the ordinary lock.

Axis-traction forceps.—It has already been explained (see pp. 632—634) how perfectly correct axis-traction may be made, theoretically at any rate, with the long curved forceps. In ordinary cases it is not difficult to carry out the plan there described, if not with perfect accuracy, yet to such an extent that the disadvantage of the ordinary forceps as regards the axis of traction is much less than the advocates of newly introduced instruments have contended. In difficult cases of the high forceps operation, however, when the resistance is very considerable, and the operator has to put out most of his strength in pulling, it is almost inevitable that he should pull nearly straight towards his chest with both arms, instead of pulling with each hand in the direction of the corresponding forearm. The direction of traction is then most defective when the force is greatest, and therefore the pressure on the pelvic wall, due to the erroneous direction, most likely to be injurious. Under these circumstances axis-traction forceps have an advantage.

In Tarnier's forceps (Figs. 224, 225, 226) the instrument, seen

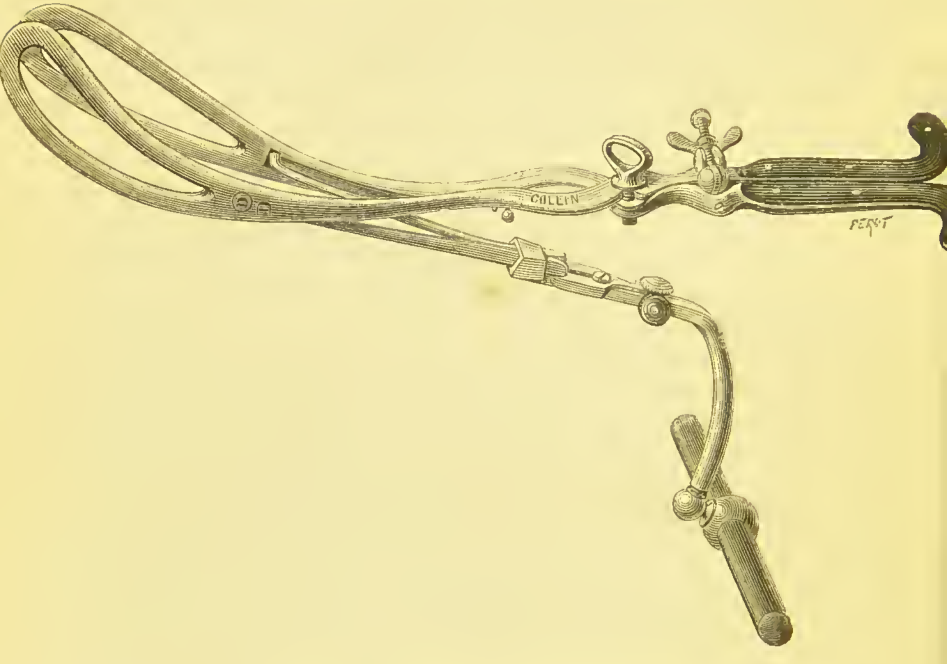

Fig. 224.—Tarnier's axis-traction forceps.

from the side, forms an S-shaped curve, so far as regards that part of it which is used for traction, the perineal curve being carried back so far that the end of it lies exactly on the axis of the upper halves of the blades. Besides the principle of axis-traction, a second principle is embodied in the instrument, namely, that of separating the "prehensile branches," or that part of it which corresponds to ordinary forceps, from the "traction rods," at the extremity of which the force is applied by means of a strong transverse bar, which allows the utmost strength of the operator to be put out by a firm grasp with both hands. The traction-rods are hinged near the lower part of the blades. In the original pattern the prehensile branches had the same S-shaped curve as the traction rods, and were to be kept close to them, the traction-rods being made in one piece. In the latest pattern (Figs. 224, 225, 226), the prehensile branches are made in the same shape as ordinary long curved forceps, so that the handles lie forward; the traction rods are divided by a joint in the middle, at which the rods belonging to each blade are affixed to a common handle (Fig. 224). This attachment is made after the prehensile branches have been introduced separately and locked. The prehensile branches take their grasp of the head and exercise compression upon it, not by being held by the hands, but by means of a screw which approximates the handles. This screw should be tightened only just when traction is made, and loosened somewhat in the intervals, that the head may not be subjected to constant pressure. The whole instrument is very stout and firm, so that the blades have the merit of stiffness in a high degree, and are, in consequence, able to hold the head with a less compressing power than would otherwise be necessary.

It is claimed that the prehensile branches form an "indicating needle," showing the direction in which to make traction at any moment, and that the handles turn forward as the head becomes extended under the influence of the pressure of the genital canal. The operator, therefore, it is said, need not trouble himself to discover in what direction he ought to pull; he has simply to keep the traction-rods close to the prehensile branches without actually pushing against them, and to pull in the direction thus indicated.

Application of Tarnier's forceps.—For introduction of Tarnier's forceps, each traction-rod is held with the corresponding prehensile branch like a single blade, the lower blade being introduced first. The two traction-rods are then brought behind the prehensile branches. The lock can then be adjusted, and the screw which approximates the handles turned till the head is sufficiently grasped. Finally the common handle is fitted over the ends of the two traction-rods. The mode in which traction is to be made has been already described.

Advantages and disadvantages of Tarnier's forceps.—The great advantage of the instrument is that it allows perfect axis-traction, the handle for pulling being situated accurately in the axis of the upper halves of the blades. I have succeeded with it in extracting a living child when the best efforts with the long curved forceps had failed. It has the following drawbacks:—It is more complicated and difficult to adjust than ordinary forceps, though in this respect the later pattern is an improvement on the former. The hinge at the blades is difficult to keep perfectly clean, whereas with ordinary forceps the part of the instrument introduced into the vulva has no point which is likely to retain septic material. With care, and by disinfection by boiling, the hinge may of course be cleaned; but facility of cleaning is a matter of considerable importance in forceps intended for ordinary use in all cases. The compression of the head 3 with a screw is also a disadvantage. With ordinary forceps the operator, almost automatically, proportions the amount of pressure to the traction force exerted. With Tarnier's forceps he cannot make the adjustment so quickly, and he may omit to loosen the screw in the intervals of traction. The thickness of the blades also takes up much room in the pelvis. In a flattened somewhat generally contracted pelvis, which is in use at Guy's Hospital, covered with indiarubber, for the demonstration of obstetric operations, a somewhat large head can be easily extracted by long curved forceps, while Tarnier's forceps (of the original pattern) fail to extract the same head, for want of space in the transverse diameter.

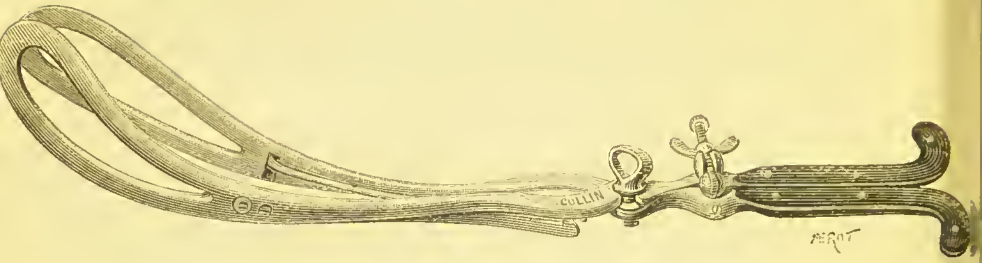

Fig. 225.—Tarnier's axis-traction forceps, with the traction-handle removed.

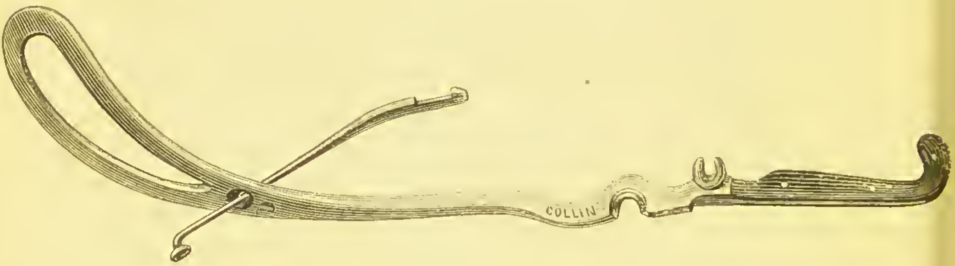

Fig. 226.—Upper or right-hand blade of Tarnier's axis-traction forceps. Traction-rod detached for cleansing of hinge (D).

The so-called "indicating needle" appears to be a delusion. The prehensile branches are too heavy, and their weight acts at too great a mechanical advantage by leverage, to allow them to move like an indicating needle, in consequence of the extension of the head. This is especially the case when, as in France, the patient is in the dorsal position. The handles do indeed turn forward as the head descends, but this is rather due to the fact that the hinges are adjusted very slightly behind the axis of the upper halves of the blades. In consequence of this, each effort of traction tends to turn the handles forward.

Other forms of axis-traction forceps.—Professor A. R. Simpson, of Edinburgh, has introduced a modification of Tarnier's forceps, formed by attaching to a pair of ordinary Simpson's forceps a pair of traction-rods hinged to the blades, and a screw to compress the head (Fig. 227). In this instrument the traction-rods, as attached to the prehensile branches, are short, and the handle which completes them is added after the blades have been locked. This is the same principle as that which Tarnier has adopted in his latest pattern. The hinge cannot be thoroughly cleaned as it can in Tarnier's forceps, because the traction-rod cannot be taken out of it in the way shown in Fig. 226, p. 644.

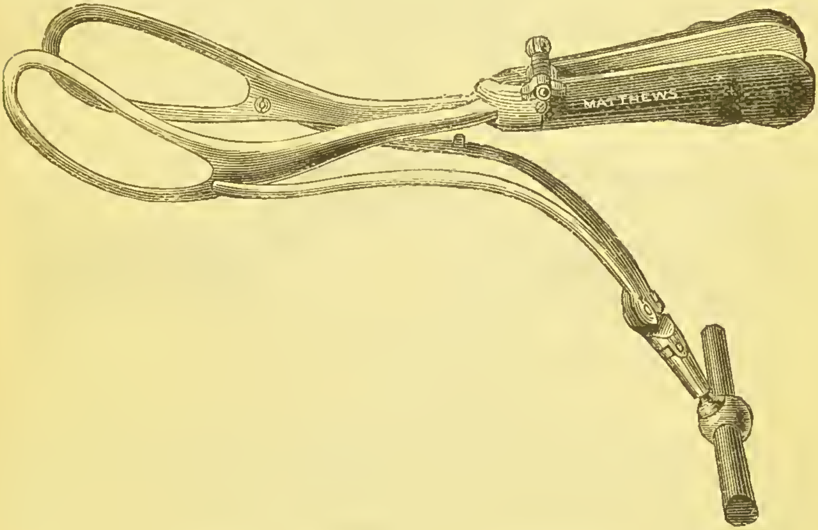

Fig. 227.—Simpson's axis-traction forceps.

In order to gain the advantage of axis-traction without the drawbacks to Tarnier's forceps, which have been enumerated above, I have had constructed the forceps shown in Fig. 228. With these, as with Tarnier's forceps, I have found that a living child can in some cases be extracted when all efforts with the ordinary long curved forceps have failed. The general shape of the instrument is similar to that invented by Moralés, of Belgium, but the perineal curve is carried back more completely to the axis of the upper halves of the blades, and the lock is the English instead of the French lock. The handles lie in the axis of the upper halves of the blades. Hence traction has to be made simply in the line of the handles, as with straight forceps, and if it is desired to rotate the head, this can be done by simply rotating the handles on their own axis. The operator must judge for himself the direction of the pelvic axis at the point where the centre of the head is lying as in the case of the ordinary forceps, and keep the handles in that direction. The lock is made in the reverse of the ordinary way, in order that the upper blade may be introduced first, and the handle held backward while the second blade is being passed.

It will be found that these forceps can be applied more easily than Tarnier's forceps. The adjustment of the lock is easier even than with ordinary forceps, because the transverse portion below the lock affords a considerable leverage in rotating the shanks by means of the handles, so as to bring the flat surfaces of the handles exactly opposite to each other, and the blades therefore into the right position to lock. These forceps may be used for the low forceps operation as well as for the high, and there is a certain convenience in the fact that the handles have not to be carried so far forward between the patient's thighs at the last stage of extraction, but merely kept always in the direction in which the head is at any moment advancing. I do not, however, recommend any form of axis-traction forceps for general use in all cases, believing that the inclination of the line of traction forwards when the head is passing the perineum is rather an advantage than a disadvantage, as tending to prevent rupture.

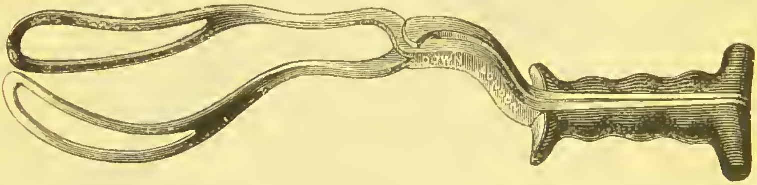

Fig. 228.—The Author's axis-traction forceps.

Forceps in occipito-posterior positions of the vertex.—So long as the occiput looks in any degree backward, the application of forceps should be deferred, if possible, or the occiput should first be rotated forwards by the vectis, in the manner previously described (see p. 606); for if the head descends under the influence of the natural forces the occiput will probably rotate forwards, but if it is grasped by

In occipito-posterior try delay using forceps as long a
mento-posterior

forceps, this rotation will almost certainly be prevented, and the danger of laceration of the perineum will thereby be increased. A plan, however, is recommended for indirectly effecting rotations of the head by means of long curved forceps. The forceps are applied with their pelvic curve reversed, so that its concavity looks towards the sacrum. In this position they do not seize the centre of the head and easily slip off. But their grasp, such as it is, is upon the occiput, and before they slip off they may effect descent of the occiput, and therefore flexion. Rotation is then likely to follow naturally. As soon as flexion is effected the forceps are to be taken off. While the occiput remains backward, forceps should only be applied for the purpose of extraction if the condition of the mother calls for their use, or if it is judged that there is no chance of rotation taking place, from the fact that the head is already low upon the perineum, and the occiput rotated backward into the hollow of the sacrum.

The blades should be applied in the same way as in occipito-anterior positions, and no attempt should be made to rotate the head artificially, but it should be extracted over the perineum with extreme care and slowness, in consequence of the increased risk of laceration. If any tendency of the occiput to rotate forwards is noticed, the blades should be completely loosened from time to time, and allowed to remain loose during a pain, so as to permit rotation of the head to take place within the blades if possible, under the influence of the natural forces.

Forceps in face presentations.—In face presentations, where the chin is directed forward, forceps may be used with almost as much advantage as in vertex presentations. The blades should be applied as nearly as possible to the sides of the face. The handles (of long curved forceps) will then be directed at first somewhat to the side. As the chin rotates under the pubic arch, the handles will turn forward.

Mento-posterior positions.—In the majority of cases, the chin is directed posteriorly or transversely. There is then considerable risk to the child in the use of forceps; for if one blade is applied over the chin, its tip will compress the neck and trachea, and is liable to do such damage that the child may be stillborn, or die shortly after birth. Hence in all such cases the rule is the same as in occipito-posterior positions of the vertex—that the case should be left to nature as long as possible, unless the condition of the mother requires interference. It is to be remembered that, although labour is more protracted than in vertex presentations, the immense majority of cases terminate naturally, if left alone.

If the head is arrested high up in face presentation, version is the best treatment if the uterus is not too rigid to allow it. If version is not admissible, and the chin posterior, forceps may be applied as nearly as possible to the sides of the head, the concavity of the pelvic curve necessarily looking toward the forehead. The head may be drawn down in this position until it rests completely upon the perineum. The forceps should then be taken off, and the chin will frequently rotate forward at the last moment under the pressure of the perineum. Sometimes it rotates only partially forwards, and the face passes the vulva almost in a transverse position. Sometimes, with a small head, the chin may be drawn over the perineum with forceps, the edge of the perineum being hooked backward over the chin as soon as possible.

If the face is arrested high up in a transverse position, and version is not admissible, the only chance for the child, although a poor one, is to apply the forceps in whatever way they will seize the head. They may be taken off as before when the head is drawn quite down upon the perineum.

If the face is arrested when resting low upon the perineum, and the chin remains posterior, the attempt may be made to effect rotation artificially, although it is dangerous to do this when the head is high up. Straight forceps are the best for this purpose. With straight forceps, the blades are applied to the sides of the head, and the handles simply rotated in their own axis, some downward traction being made at the same time. It is possible, however, to carry out the same thing with curved forceps. The blades are applied to the sides of the head, the concavity of the pelvic curve necessarily looking toward the forehead. Rotation is effected by carrying the handles more to the side and in a backward direction, the head being at the same time firmly grasped. As soon as the handles begin to look somewhat posteriorly and the chin somewhat anteriorly, the forceps are taken off, and reapplied with the concavity of the pelvic curve toward the chin. Extraction is then easily completed by drawing downward and at the same time aiding the rotation of the handles to the front.

Forceps applied to the after-coming head.—The value of the application of forceps in head-last cases has been very variously estimated by different authorities. The difference may depend upon the degree of dexterity with which operators have tried other modes of extraction. When the resistance is due to soft parts only, forceps will rarely, if ever, be required, if the method of extraction previously described (see pp. 254—257) is properly carried out.

When the resistance is due to the pelvis, the very short space within which the child must be extracted if extracted alive, allows but little time for the application of the blades, somewhat impeded by the presence of the child's body, and for extraction, especially if time has already been occupied by attempts to extract by pulling the trunk. It has already been shown that, in flattened pelves, delivery by traction after version has generally the advantage over the application of forceps to the fore-coming head (see pp. 540—543). It is hardly likely, therefore, that in such pelves the application of forceps should be the best mode of extracting the after-coming head, for some of the disadvantages attending the use of forceps in flattened pelves will exist in this case also. For instance, the pressure of the blades will have the same tendency to displace the long diameter of the head out of the transverse diameter of the pelvis, and to bulge out the diameter which is engaged in the contracted conjugate by pressure exerted in the opposite diameter. Also the extraction must be effected rapidly instead of deliberately, if the child is to be saved. The only advantage is that greater force may be exerted. Accordingly, although some authorities speak highly of the application of forceps to the after-coming head, I have not found it so efficacious as traction on the body, combined, if necessary, with jaw-traction. It may be preferable, however, in the case of the pelvis æquabiliter justo minor, or one contracted in its transverse diameter. Even in the flattened pelvis, it may be tried if the other method fails.

For application of forceps to the after-coming head, the body of the child should be drawn as much forward as possible, and held forward between the patient's thighs by an assistant who grasps the legs. The arms should be previously released, if extended above the head, and these also should be kept forward. The blades of the forceps are then to be introduced posterior to the child's body, and so applied to the head. If necessary, a moderate degree of traction applied by an assistant to the body may be combined with the force exerted by the forceps upon the head. Such traction may assist in elongating the head, and so enabling it to pass the brim.

cephalic = head
Podalic = feet.

CHAPTER XXXIV.

VERSION.

By version is meant the operation for altering the position of the fœtus, so that the presenting part is changed, and one or other pole of the fœtus is brought over the os uteri. Classifying the operation according to the part of the fœtus which is made to present, the chief varieties of version are cephalic version, in which the head is made to present, and podalic version, in which one or both feet are brought down. Pelvic version, in which the breech is made to present without a foot being brought down, is rarely performed. According to the mode of its performance, version is divided into three classes—external version, effected by external manipulations only: internal version, effected by the hand introduced within the uterus, the external hand being used only to steady the uterus; and the combined external and internal version, in which one hand is used in the vagina and the other moves the fœtus by pressure through the abdomen.

History.—Version is a very ancient operation. Before the introduction of forceps it was used more than it is at present, because, in cases of contracted pelvis, it was the only possible mode of saving the fœtus. Cephalic version, recommended by Hippocrates, was at first alone in use, and was employed even in pelvic presentations. Podalic version was introduced in the latter part of the sixteenth century, and taught by Paré, Guillemeau, Mauriceau, and others. On account of the greater facility of podalic version, cephalic version afterwards fell almost entirely out of use, until revived, for a certain limited class of cases, by recent authorities.

Cephalic version.—For the performance of cephalic version it is essential either that the membranes should be intact, and the fœtus moveable in the liquor amnii, or at any rate, that the liquor amnii should have only recently escaped, and the uterus be quite lax, so as to allow ready mobility of the fœtus. Cephalic version should not be attempted in any case in which rapid delivery is called for, or in any case of flattened pelvis in which there is any considerable contraction of the conjugate diameter, for in such pelves the head is likely to pass better when it enters the brim with the base first. With these exceptions, cephalic version is preferable to podalic in all cases of shoulder or transverse presentation in which it can be performed without much difficulty, for the risk to the child is much less if it passes with the head first than if it is extracted by the feet. Cephalic version, howerer, frequently requires more dexterity on the part of the operator than the ordinary podalic version.

Cephalic version by the external method.—Cephalic version by external manipulation only is chiefly available for those cases in which a transverse or oblique position of the axis of the fœtus is discovered before the onset of labour. It may be employed, however, even after labour has commenced, provided that the liquor amnii is intact, and the uterus is completely relaxed in the interval of pains. For the operation the patient is placed on her back, the head rested on a low pillow, the abdomen uncovered, or covered only by a thin garment. As much relaxation as possible of the abdominal muscles should be secured. It is essential that it should be possible to make out with certainty, by external palpation, the parts of the fœtus, especially the head and the breech, the head being distinguished by its hardness and uniform rounded form. Then, at a time when the uterus is completely lax, the head is pushed toward the os uteri with one hand, and the breech toward the fundus with the other. In many cases the fœtus rotates with great facility, especially if its long axis was originally transverse. Frequently, however, the displacement is liable to occur again, from the same cause which produced it in the first instance. There is, however, no harm in making the reposition once, even if the axis of the child again gets out of position. The only thing necessary, if labour has not yet come on, is to take care that the fœtus is again restored to the right position in the early stage of labour and before the rupture of the membranes.

Supposing that labour has commenced, and that the head has been brought over the os uteri, the patient should be kept quiet in bed, and not allowed to walk about, lest the malposition be reproduced through displacement of the fundus uteri. In general it is better to keep the patient uniformly on her back, so that there may be no inclination of the fundus to one side or the other. If, however, there is a marked natural inclination of the fundus toward one side, it may be desirable to counteract this by making the patient lie on the opposite side, or with some inclination toward the opposite side. As soon as dilatation of the os has progressed to some extent, the fixation of the head in the pelvis will be promoted by rupturing the membranes.

Cephalic version by the combined external and internal method.—In former days cephalic version was performed by passing the hand into the uterus, grasping the head, and drawing it toward the os. As this was a more difficult operation than the ordinary podalic version, and one which involved more risk of injury to the mother, it rightly fell into disuse. Various methods of combining the action of the two hands, one passed into the vagina, and one applied externally to the abdomen, have been described by Busch, Hohl, and Wright of Cincinnati. The plan, however, which can be employed with least disturbance to the mother is that first published by Dr. Braxton Hicks,* which can be carried out when only one or two fingers can be passed through the cervix. Whenever a shoulder presentation is discovered before the rupture of the membranes, and there is no contraction of moment of the conjugate diameter of the pelvis, and no other reason for interference than the malposition of the fœtus, it is worth while to endeavour to secure a head presentation by this method. Even when the liquor amnii has escaped it may be possible to carry it out, provided that it has escaped only recently. Even descent of the arm is not considered by Dr. Hicks as a contra-indication; but in such case, the arm must first be returned across the chest. Generally when the arm is prolapsed, the fœtus will not be moveable enough to allow cephalic version.

Method of operating.—The bladder and rectum should be empty, as in all obstetric operations. Anæsthesia is not absolutely necessary, but it always facilitates the operation, and should be employed at any rate in those cases in which the introduction of the hand into the vagina is difficult or excites spasm, or in which the uterus is contracting frequently, and there is a risk that the membranes will be ruptured. Dr. Hicks recommends that the patient should be placed on the left side, and the left hand introduced into the vagina, as for podalic version. The position of the head and breech must be first made out, and these parts recognised by external palpation. Then one or two fingers are introduced through the cervix, placed upon the apex of the shoulder, and the shoulder is by their means pushed upward in the direction of the breech and away from the head. As soon as the shoulder begins to recede, the external hand, placed upon the abdomen over the head, pushes the head down into the pelvic brim over the os uteri. The shoulder still rising, the head can be received upon the tips of the inside fingers.

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* "Combined External and Internal Version," 1864.

The head will play like a ball between the two hands, the membranes being still intact, and can be adjusted at will over the os. If the breech does not readily rise to the fundus after the head is fairly in the os, the hand should be withdrawn from the vagina, and used to push up the breech from the exterior in the direction of the fundus. It is only at this last stage that the method becomes truly "bipolar," the forces being applied to the opposite ends of the fœtus.

Choice of position.—When the head is displaced toward the patient's left side, and the breech therefore toward the right, there is no doubt that it is best to make her lie on her left side, as recommended by Dr. Hicks, for then gravity assists the movement of the breech toward the fundus. When, however the head is displaced to the right side and the breech to the left, I have found it better, in order to get a similar assistance from the action of gravity on the fundus uteri and the breech towards rectifying the position of the child's axis, to place the patient on her right side. The right hand may then be passed into the vagina, and the left hand used externally over the abdomen.

Some have recommended the use of the knee-elbow position, that the fœtus may gravitate away from the pelvic brim, and so the recession of the shoulder may be facilitated. When vaginal space is ample and the patient tolerant, so that an anæsthetic may be dispensed with, the position may be tried, if the shoulder is not found easily to recede with the lateral position. In other cases an approximation may be made to the effect of the knee-elbow position by adopting, instead of the simple lateral position, Sim's semi-prone position, in which the lower arm is extended straight behind the back, the chest is rotated so as to rest downward against the bed, and the upper knee is flexed more than the lower, the knee also being in contact with the bed.

Podalic version.—Podalic version is to be performed in all cases of shoulder or transverse presentation in which cephalic version is contra-indicated, or cannot readily be carried out. These comprise much the largest proportion of the whole. Podalic version is also indicated when the head is presenting in many cases of placenta prævia, in some of accidental hæmorrhage, in certain cases of flattened pelvis, in some of prolapse of the funis, and also in cases in which rapid delivery is called for on account of some perilous condition of the mother, such as eclampsia. The grounds for deciding on the operation in any given case are considered under their respective headings. Podalic version may be performed either by the combined internal and external, otherwise called the bipolar, or by the internal method.

The combined internal and external method for podalic as well for cephalic version, as it is now generally carried out, was first described by Dr. Braxton Hicks. Priority has been claimed for Dr. Wright of Cincinnati, who also recommended the combined use of two hands, but his method was not precisely the same.

Bipolar version in head presentation.—The essential principle of the method consists in the use of the internal hand (to push away from the os that pole of the trunk of the fœtus (in shoulder presentations), or of the whole fœtus (in head presentations), which is occupying it, and of the external hand to bring down the opposite pole into the os. Its great merit is that it can be employed at any early stage of labour, when the os is only enough dilated to admit two fingers, and that it avoids the risk to the mother which is incurred by forcibly dilating the cervix in order to introduce the hand into the uterus. For its performance, it is essential that the uterus should be so relaxed as to allow the fœtus to move readily, and therefore that the liquor amnii shall not have drained away so completely that its walls have closely clasped the fœtus. When the membranes are still intact, the fœtus can generally be rotated with surprising ease.

Anæsthesia.—In all cases of version, there is nothing which facilitates the operation so much as complete anæsthesia, and a comparatively inexperienced operator will find it especially valuable. Chloroform has some advantages over other anæsthetics, since, when given fully, it relaxes the uterus more completely. There is also less risk attending its use in puerperal women than in average patients, as has already been explained. The anæsthetic should be given to the full surgical degree, so that the voluntary muscles are relaxed, and the uterus is rendered as flaccid as possible. If possible, there should be an assistant to administer the anæsthetic. If it is impossible to obtain a skilled assistant, the operator may first place the patient fully under its influence, and then rapidly perform the version before she recovers sensation. An anæsthetic is not, however, absolutely essential for the operation, especially if the operator is dexterous, and the vagina wide enough to admit the hand easily.

Position of the patient, and choice of hand to be introduced.—In this country the patient is usually placed on her left side in the ordinary obstetric position. The hips should be brought to the edge of the bed, the trunk placed transversely, and the thighs bent up toward the abdomen. The right thigh should be held up by the nurse or other assistant, so that the right arm may reach the abdomen by passing between the thighs. The left hand should be introduced into the vagina as a rule, because it passes more easily along the curve of the genital canal, and the right hand can more easily reach the abdomen. If, for any reason, as for instance on account of a cut finger, the operator prefers to introduce his right hand, he can do so with equal advantage by placing the patient on her right side instead of on her left. If the bed is low, the operator will find it most convenient to sit down opposite the hips.

Some may prefer to place the patient in the lithotomy position.

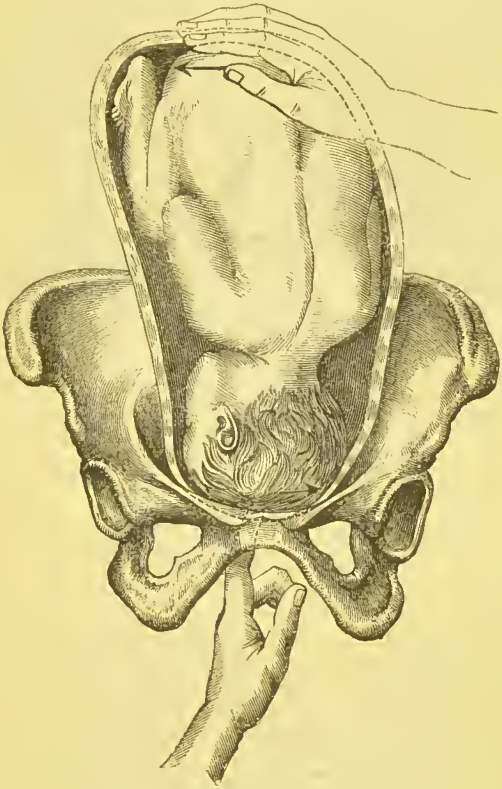

Fig. 229.—First stage of bipolar version. (After R. Barnes.)

The operator then stands or sits between the thighs, which are both supported by assistants. Either hand may be introduced. It is better to choose the hand so that its flexor surface will correspond to the abdominal surface of the fœtus when it is introduced. Thus the right hand should be chosen if the abdomen of the fœtus is directed toward the operator's right side, and *vice versâ*.

Time for operating.—It is of great importance that the version should be performed before the rupture of the membranes. If the liquor amnii has escaped at all, it is more difficult, and it is rarely possible to turn by the bipolar method when the membranes have been ruptured long. A dilatation of the cervix sufficient to admit two fingers is sufficient, but it is easier to bring the leg through the os if a somewhat greater size than this has been reached.

Method of operating.—First of all, the exact position of the fœtus must be determined. This is to be done by abdominal palpation and by feeling the sutures and fontanelles. If any doubt whatever exists, a final determination must be made after the left hand is introduced into the vagina, by feeling an ear, or by recognising the orbits, nose, or face.

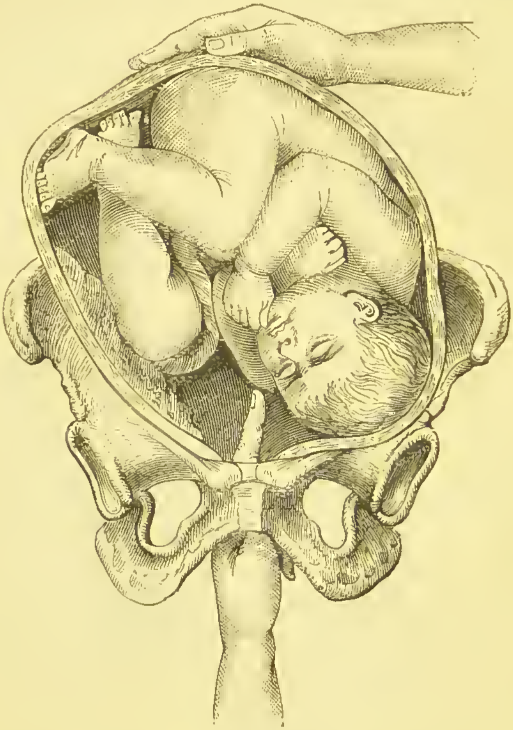

Fig. 230.—Second part of first stage of bipolar version.

The coat should be removed, the left shirt-sleeve turned up above the elbow, and the dorsal surface of the left hand and the whole of the wrist well lubricated with an antiseptic lubricant, having first been disinfected with perchloride of mercury 1 in 1000. The left hand is then passed into the vagina sufficiently far to allow two fingers to be passed their full length through the cervix. The operation is generally easier if the whole hand is passed into the vagina, but this is not always absolutely necessary. If the cervix lies low, a dexterous operator may turn by passing four fingers only into the vagina, keeping the thumb outside.

First stage.—One or two fingers are passed through the cervix, and rested upon the presenting part of the head, while the external hand is placed upon the abdomen, over the breech. The fingers then push the head upwards and *in the direction of the occiput* (see Fig. 229, p. 655). The reason for this is that, if the head were pushed in any other direction, the back or side of the fœtus would come down over the os, and not the knees, which always lie in front of the abdomen. As the fingers push the head up, the external hand pushes the breech downward, and in the direction of the abdomen of the fœtus (see Fig. 229). The pressure is to be continued until the head has receded as far as the fingers can reach to push it (see Fig. 230, p. 656).

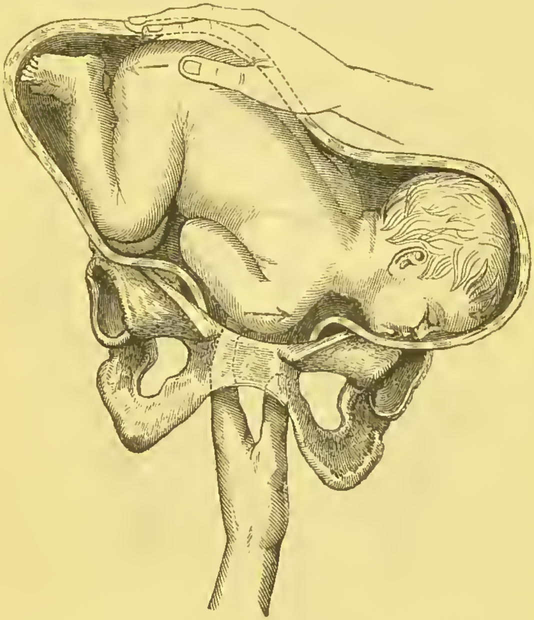

Fig. 231.—Second part of first stage of bipolar version, when head becomes extended. (After R. Barnes.)

Second stage.—As the head thus recedes, the fœtus generally preserves its attitude of general flexion, provided that a good deal of liquor amnii is still retained, and the limbs are the next parts which the internal fingers are able to touch. In this case the second stage of version is that the right hand continues to press down the breech toward the brim, and so brings the knees within reach of the internal finger, which secures one of them (Fig. 232). If, however, but little liquor amnii remains, and the uterus envelops the fœtus more closely, the head may become extended as it is pushed away by the fingers, and the shoulder or chest may be felt over the os by the internal fingers. In this case there is an intermediate stage in which the shoulder or chest is pushed by the internal fingers in the direction of the head, the right hand continuing to press the breech in the opposite direction and downward (Fig. 231). The knee is distinguished from the elbow by its pointing towards the head, and not away from it (see Fig. 232). As soon as a knee is seized, the membranes are to be ruptured at this point, if they have not been ruptured already, and the index finger hooked into the flexure of the knee.

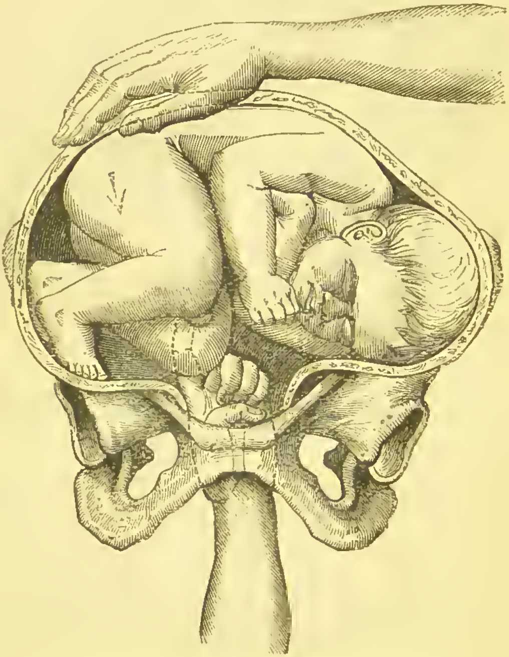

Fig. 232.—Second stage of bipolar version.

POINTS TO HEAD

POINTS AWAY.

3 *Third stage.*—As soon as the knee is firmly secured by the finger, the external hand is transferred from the breech, and placed on the other side of the abdomen over the head, so as to push the head up toward the fundus while the finger draws the knee through the os (Fig. 233, p. 659). When the knee has been brought through the

os into the vagina the foot should be brought down, so that the operator, by feeling the heel, may assure himself positively that he has secured a leg and not an arm (Fig. 234, p. 660).

Traction should be made upon the leg, until the greater part of the thigh has passed through the os, and the half-breech is beginning to enter it. This will bring the foot outside the vulva. If this is not done, and the leg only passes through the os as far as the knee, the breech may remain at some distance from the os, the long axis of the fœtus may still be diagonal or nearly transverse, and the progress of labour is liable to be arrested. When the half-breech is once brought fully into the os, the head is sure to rise to the fundus. It will be observed that the action of the two hands is strictly bipolar in the first and third stages, but not in the second, in which the right hand presses down the breech for the left fingers to seize the knee.

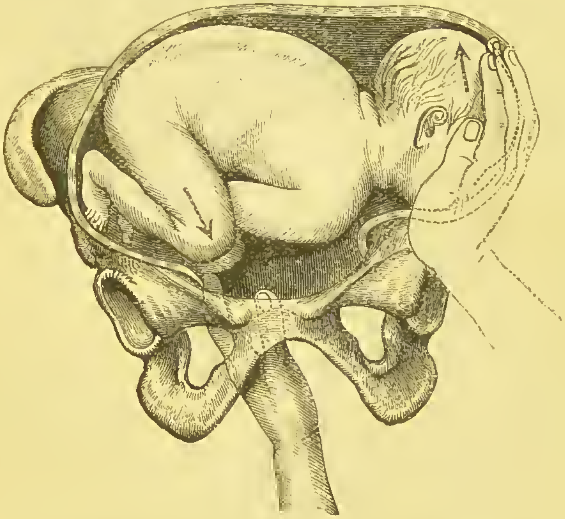

Fig. 233.—Commencement of third stage of bipolar version. (After R. Barnes.

In some cases, especially when liquor amnii is abundant, the fœtus is so very mobile, and rotates in any direction so easily, that it is difficult to catch a knee. If the foot can be touched before the knee, and positively identified as a foot, by feeling the heel, it may be caught between the index and middle fingers, and brought through the os. Otherwise it is better to rupture the membranes, and then seek the knee or foot, which will be brought nearer to the os, and will be less mobile, as the liquor amnii escapes. The presence of the hand and wrist in the vagina generally prevents any too sudden and complete escape of the liquor amnii. Sometimes the long axis of the fœtus may have become completely turned round, so as to produce a breech presentation, before the leg is seized.

Choice of the leg to seize.—When version is performed in head presentations, it generally makes no difference which leg is seized, and therefore the knee or foot which comes first may be taken.

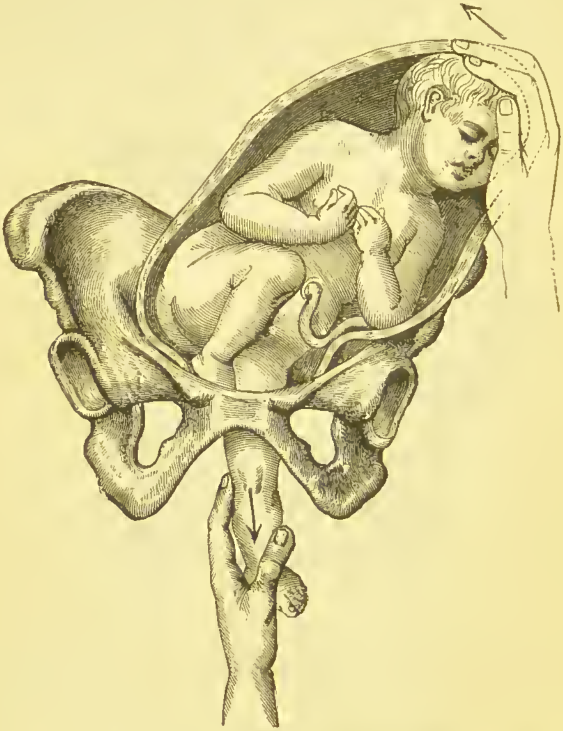

Fig. 234.—Second part of third stage of bipolar version. (After R. Barnes.)

There is, however, one exception to this rule. When version is performed on account of a flattened pelvis, and it has been made out that there is more room on one side of the pelvis than on the other, on account of greater width of the sacral wing on one side, or any other reason, it is desirable to bring the occiput toward the wider side. Fig. 185 (p. 543) shows a pelvis of this kind, and it will be obvious from this figure how it is that the head adapts itself better to the pelvis when the biparietal diameter is on the wider side. Since the leg which is brought down always eventually rotates forward, the object may be gained by seizing that leg which it is desired to bring to the front. Thus, if the left side of the pelvis is the widest (as in Fig. 185), the left leg should be seized, and *vice versâ*.

As it is difficult to select the leg when only one or two fingers are passed through the os uteri, it is better to wait, in such cases, for a somewhat greater dilatation of the os before undertaking version. The hand may then be passed through the os to select the leg, if it cannot otherwise be made out which is right and which is left.

Bipolar version in shoulder presentations.—Bipolar version is not so often available in shoulder as in head representations; for, if the membranes are intact, it is generally right to attempt cephalic version, and, after their rupture, the liquor amnii quickly drains away, and the uterus grasps the fœtus too closely to allow it to be turned in this manner. In all cases, however, in which the membranes have not been long ruptured, the bipolar method may be attempted in the first instance without any disadvantage; for if the shoulder cannot be made to recede by pressure with the fingers passed through the cervix, it is easy, provided that the cervix is sufficiently dilated, to pass the hand on into the uterus, without withdrawing it from the vagina, and seek the knee or foot.

The two poles which have now to be regarded are, in the first instance, not the poles of the whole fœtus, namely, the breech and head, but the poles of the trunk apart from the head—that is to say, the breech and shoulder. The position is similar to that in the exceptional stage of bipolar version shown in Fig. 231, p. 657. The fingers passed through the cervix first push the shoulder upwards, in the direction of the head and somewhat toward the back of the fœtus, so that its abdominal surface is brought over the os. At the same time the external hand is used to press down the breech in the direction of the os. If the shoulder can be made to recede, the knee is sought for and hooked by the finger in the same way as in head presentations. As soon as the knee is thus secured, the external hand is transferred from the breech to the head, and presses the head up toward the fundus, as in Fig. 233, p. 659. At this stage, therefore, the two forces are applied to the poles of the entire fœtus. The whole proceeding is, of course, comparatively easy if the liquor amnii is still intact.

If the shoulder cannot easily be made to recede by the direct pressure of the fingers, and the arm is prolapsed in the vagina, it is sometimes of use to grasp the humerus with the hand in the vagina, and use it as a kind of handle to push the shoulder in the required direction.

Internal version in head presentations.—Internal version has been employed so much more extensively than any other kind of version, that it is generally regarded as version *par excellence.* The object is to seize one leg, and bring it through the os into the vagina. Then, by traction exerted on the breech through the medium of this leg, the fœtus is made to rotate; whatever part was previously presenting is thereby caused to recede, and the half-breech is brought into the os. The reason for bringing down one leg only and not both legs is that the half-breech forms a better dilator for the cervix and other soft parts than the two thighs side by side, and therefore there is less risk of the after-coming head being delayed, and the child's life lost in consequence. If the child is previously dead, in the case of shoulder presentation, there is sometimes an advantage in bringing down both legs.

Choice of hand to introduce.—As a general rule the patient may be placed on the left side, and the left hand used for all cases, since it adapts itself better to the pelvic curve. Whatever be the position of the fœtus, the left hand can, as a rule, reach its abdominal surface, and so find the knees; for the abdomen never looks directly forward, even in occipito-posterior positions of the vertex. By supinating the forearm, the hand may be brought to reach the left side of the pelvis; by pronating it, to reach the right side. By this means the posterior leg at any rate can be reached by the left hand, even in occipito-posterior positions of the fœtus. In occipito-anterior positions the left hand has not to diverge far from the posterior wall of the genital canal.

In cases of flattened pelvis, there is generally posterior obliquity of the uterine axis in reference to the axis of the brim, especially if the pelvic inclination is increased. Under these circumstances, if the legs and feet lie against the posterior wall of the fundus, it is necessary to bend back the wrist, after passing the promontory of the sacrum, in order to reach them. This is sometimes difficult if the uterus is at all tightly contracted. If necessary the left arm may be withdrawn, and the right arm introduced in order to seize the leg; for although the left arm adapts itself better to the pelvic curve, the right arm does so better to the "curve of the false promontory."

The primary choice of the hand to introduce is not a matter of great consequence, and different authorities have given different rules on the subject. If the patient is placed on her back, the right hand may be chosen if the abdomen of the child is directed toward the right of the operator (see Fig. 235, p. 663), and *vice versâ.*

Preparations.—In cases where internal version is necessary, complete anæsthesia is even more important than in those in which it is possible to perform bipolar version, in order to facilitate the operation by securing the greatest possible relaxation of the uterus.

The patient's right knee is to be raised, as in the former case, that the right hand may have access to the abdomen, and make counter-pressure on the breech to support it, even if it is not able actually to bring it nearer to the internal hand. Not only the dorsal surface of the hand, but the whole of the forearm should be thoroughly lubricated, and it is well to introduce a lump of the lubricant into the vagina.

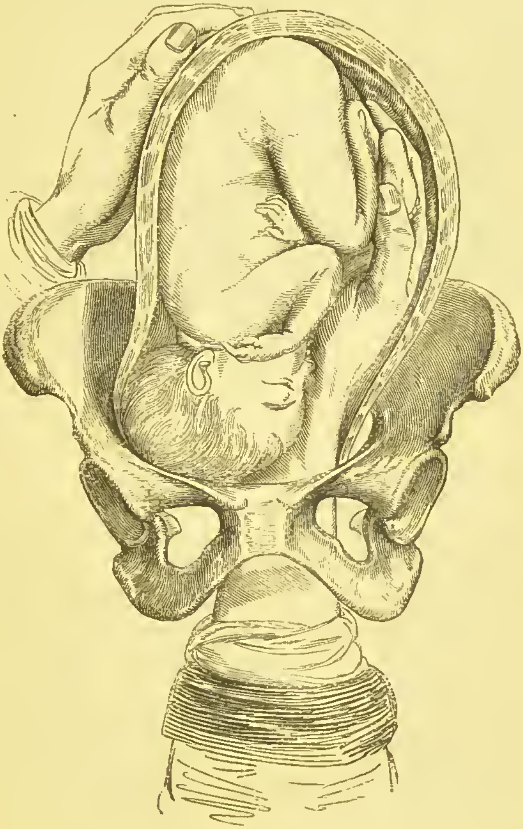

Fig. 235.—Internal version in head presentation. Seizing the leg. (After Tyler Smith.

Method of operating.—The whole hand is gently and slowly passed into the vagina, the fingers being held together in the form of a cone. If the cervix is not dilated enough to allow the hand to pass, it must be gradually stretched by pressing the fingers into it in the same conical form, until there is room for the hand to pass it. The exact position of the fœtus should have been previously made out. The operator must now verify his diagnosis, as the hand passes into the uterus, by feeling the face. The direction of the face will guide the hand toward the abdominal surface of the fœtus, up which it ought to pass. To make room for the hand to pass, the head must be pushed out of the way. In doing this the operator should carry out in some degree the principle of bipolar version, even though it is impossible to do so fully. That is to say, he should push the head in the direction of the occiput, in order to bring the abdominal surface of the fœtus toward the internal hand, and should at the same time make counter-pressure on the breech with the external hand (Fig. 235).

Seizing the knee.—The hand and arm should be gradually passed up toward the fundus in the absence of a pain, the external hand still making counter-pressure over the uterus, until the hand reaches the child's abdomen. If a pain comes on during the operation, the hand must be allowed to lie flat against the uterine wall until it has passed off. As the hand passes the head, it sometimes happens that a ring projecting inwards, formed by contraction of the internal os, is detected above the head. In such case, the attempt to turn should be given up; for this condition implies that the cervix has undergone dangerous thinning through retraction of the body of the uterus in prolonged labour, and that the uterus has closed tightly round the fœtus after escape of the liquor amnii. If an attempt is made to force the head back over the projecting ring, there is a risk of causing rupture.

The older authors generally recommend that a foot should be seized. The knee is preferable, for two reasons. In the first place, it is nearer, and generally is reached first. Secondly, it can be secured by hooking the forefinger into the flexure of the joint. The foot cannot be held securely without the use of the thumb, and, when the thumb is used, the closed fist occupies more space, and cannot therefore be so easily withdrawn. The knees will be found near the elbows, and not far from the level of the umbilicus. A knee is distinguished from an elbow—first, by its being broader, and not having the sharp projection of the olecranon; secondly, by its pointing toward the head, while the elbow points away from it. In case of any doubt being felt, the finger should be passed up the limb to feel the breech, or the foot, which can be verified by the heel. In general, whichever leg comes first should be taken. It is only necessary to make a selection in the exceptional case before mentioned (see p. 660), in which it is desired to bring the occiput into the wider side of an unequal pelvis. If the foot happens to be reached more readily than the knee, it may be taken instead.

The forefinger, having secured the knee, draws it downward through the os uteri, and thereby affects rotation of the fœtus and recession of the head. As soon as the leg is in the vagina, the foot is brought down. Traction is then to be made upon the leg, until the half-breech has fully entered the os, and the head has ascended to the fundus. The ascent of the head, in the later stage, may be assisted by pressure upwards with the external hand, as in Fig. 233, p. 659.

If the fœtus cannot be made to rotate by traction upon the knee or foot, the expedients may be tried which will shortly be described as available in difficult versions for shoulder presentation. But, if resistance is great, it is generally better not to persevere with the version, since, in head presentation, it is usually undertaken only for the sake of the fœtus.

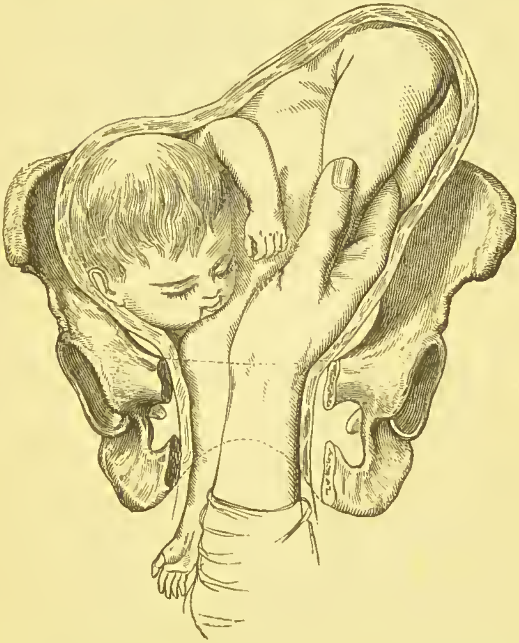

Fig. 236. Version by leg diagonally opposite to presenting shoulder, as recommended by most British authorities. (After Tyler Smith.)

Internal version in shoulder presentations.—The left hand may be introduced as a rule, in all cases, as in the other forms of version, the patient being placed on the left side; for since, even in dorso-posterior positions, the abdomen does not look exactly forwards, but is inclined to one side, the hand can always be carried far enough round one side or other of the pelvis to reach the posterior or lower knee. Some authors, however, recommend the use of the left hand in dorso-anterior positions, the right hand in dorso-posterior positions (see Fig. 236). It is to be remembered that the operator can always reverse the hand to be used, if he desires to do so, by reversing the position of the patient. Sometimes also there is an advantage in the use of the right hand, to correspond with the curve of the false promontory, and reach the legs when lying far back in the fundus uteri, as described for the case of version in head presentation. If the patient is placed on her back, the right hand may be used if the child's abdomen looks towards the mother's left, and conversely (see Fig. 239, p. 670).

Choice of leg to seize.—In general it is preferable to seize the lower leg, or that on the same side as the presenting shoulder. This is always nearer and easier to reach, in some cases very much easier, than the upper leg, or that diagonally opposite to the presenting shoulder. If it is seized, the nearest part of the half-breech is brought to the os uteri by the shortest path, and the fœtus is turned in the bilateral plane of its trunk—that is to say, around an antero-posterior axis passing through the centre of the trunk. This corresponds to version in the plane of the paper in Fig. 237, p. 667. This is the simplest kind of version which can effect the desired object, since no complete rotation of the long axis of the fœtus is necessary. Its position being already oblique, it is sufficient to turn it through an angle of not much more than 100° to bring the half-breech into the os. The back of the fœtus, which is generally anterior to begin with, remains anterior after the version—that is to say, it remains in the most favourable position.

The contrary doctrine has been taught in most of the leading English text-books. It was laid down by Sir James Simpson that the facility of version depended upon seizing the leg of the opposite side of the body to the presenting shoulder (Fig. 236, p. 665). The reason he gave for this was that to seize the leg of the same side merely bent the body forward upon the transverse axis of the trunk, but to seize the leg of the opposite side also rotated it upon the longitudinal axis of the trunk. He considered that the former action was liable to bring down the lower extremity without displacing the upper, so that the shoulder and half-breech of the same side became jammed together in the os. But rotation of the body at the same time on its longitudinal axis, by traction made upon the opposite pole to the presenting shoulder, he believed to elevate and turn away from the os uteri the part originally presenting. Sir James Simpson has been followed by Tyler Smith, Barnes, Meadows, and Playfair. On the other hand, most of the foreign authorities recommend version by the lower leg. It is also certain that those who do not trouble themselves particularly to make out which leg they have seized will turn, in almost all cases, by the lower leg, since this is so much easier to reach. It appears that Sir James Simpson and those who followed him have overlooked the fact that in version by the lower leg there is generally no bending forward of the body upon the transverse axis of the trunk, leading to a reversal of the direction of the back when the version is complete, but merely a partial rotation upon an antero-posterior axis, the direction of the back remaining unaltered. Not only is this the simplest mode in which the required change of position can be produced, but it may be shown that the force applied to the leg acts at a greater mechanical advantage in producing this rotation than traction

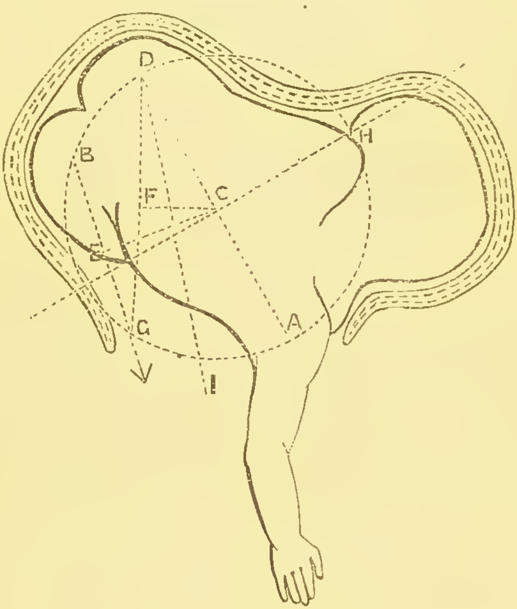

Fig. 237.—Section in bilateral plane of fœtus presenting by shoulder. C, centre of fœtal trunk; B G, direction of traction on lower hip; D G, direction of traction on upper hip; C E, C F, perpendiculars from C on B G, D G; C H is drawn perpendicular to A D; C E = 134; C F = 90.

applied to the upper leg in producing a combined rotation of the trunk of the fœtus about a transverse and a longitudinal axis, so as to bring into the os the opposite pole to the shoulder originally presenting. For, if traction is applied to the lower hip, the leverage or moment of the tractile force in producing a rotation of the fœtus round its centre on an antero-posterior axis is measured by the perpendicular C E (Fig. 237). But if traction is applied to the upper hip, its leverage or moment in producing the same rotation is measured by the perpendicular C F, smaller than C E; and its leverage or moment in producing the combined rotation on the longitudinal and transverse axis of the trunk, described by Sir James Simpson, is measured by the perpendicular C′ K (Fig. 238), also smaller than C E. Since C F in Fig. 237 is slightly larger than C′ K in Fig. 238, it is probable that, even if the upper leg be taken the rotation produced will be one on the antero-posterior axis of the fœtus, and not the combined rotation on the longitudinal and transverse axis, by which the direction of the back would be reversed.* It is found practically, that, if the lower leg be taken, the half-breech and shoulder do not in general become jammed together in the os, but the shoulder recedes.

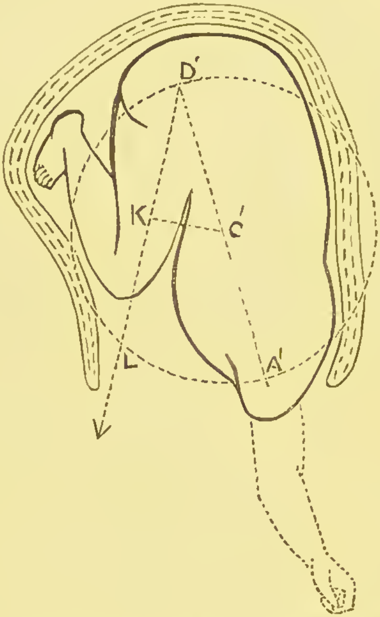

Fig. 238.—Section in antero-posterior plane of fœtus passing through right or presenting shoulder, and opposite or left hip, the plane in which the compound rotation of the fœtus on its longitudinal and transverse axis would take place. D′ L, direction of traction on upper hip; C′, centre of fœtal trunk; C′ K, perpendicular from C′ on D′ L; C′ K = 85.

Application of noose to prolapsed arm.—There is an advantage to be gained by placing a noose of tape round the wrist of the prolapsed arm, and even in drawing the arm down for this purpose if it is easily reached. This will give the operator complete control over this arm, and he will always be able to prevent it becoming extended above the head, and so delaying the passage of the fœtus through the brim. The advantage of the expedient is still greater if the version is made by the leg belonging to the same side as the presenting shoulder; for since the leg which is brought down always rotates eventually to the front, the arm which is commanded will always in that case be the anterior arm. Now the posterior arm is always much more easy to bring down than the anterior; for as the fœtus is drawn in the direction of the pelvic outlet, the posterior shoulder, and therefore the posterior arm, are much lower in reference to the pelvic brim than the anterior, and more easily reached in consequence (see Fig. 109, p. 249). Also there is more room posteriorly for the hand to pass up. Hence if the operator has command of the anterior arm by means of the noose, he will be able to deal with the posterior arm without difficulty, and the child's life is not likely to be lost through the extension of the arms.*

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* For a full discussion of the subject see a paper by the author "On the Choice of the Leg in Version." Obstet. Trans., 1877.

Method of operating.—The hand is introduced through the os uteri as in version performed in head presentation. The exact position of the fœtus should have been previously made out. The hand, as it passes into the uterus, verifies the diagnosis by making out the axilla, and the direction of the neck and head. In pushing the shoulder aside in order to make room for the hand to pass, the operator should push it in the direction of the head and toward the back of the fœtus, as well as upward, so as to bring the abdomen nearer to his hand. At the same time the external hand makes counter-pressure upon the breech, so as to diminish the strain upon the uterine attachments, and also to bring the breech, if possible, somewhat nearer to the os. The hand is then passed on from the shoulder to the front of the chest, and thence to the abdomen, and there seeks for the lower knee, or that belonging to the same side as the presenting shoulder (Fig. 239). The operator distinguishes a knee from an elbow in the manner already described (see p. 664), and one knee from the other by tracing the limb up to the breech or foot. The index finger is hooked into the flexure of the knee and draws it through the os. The external hand may then assist the rotation of the fœtus by pushing the head up toward the fundus. As soon as the leg is in the vagina the foot is brought down, and traction made upon it until the half breech has entered the os and the foot is outside the vulva. The rotation of the fœtus will then be complete. In dorso-posterior positions, the hand, on reaching the back of the shoulder, should be carried round toward the side of the pelvis opposite to that where the head is situated. Passing along the side of the fœtus, it is thereby guided to the thigh and knee corresponding to the presenting shoulder. If the left hand cannot reach the knee or foot in this way, it should be withdrawn and the right hand introduced.

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* The application of a noose to the prolapsed arm is not generally recommended in English text-books, but many foreign authors of various dates have regarded it as useful, and some have even recommended the application of the noose within the uterus. Among these who speak in favour of the noose are Osiander, Hohl, Scanzoni, Levret, Depaul, Crédé, Hodge, Schrœder, Tarnier, Fritsch, and Pinard. Dr. Roper has also used it in the Royal Maternity Charity.

Version in impacted shoulder presentation.—When the membranes have long been ruptured, and the uterus is closely contracted around the child, there may be difficulty in getting the child to revolve after the leg has been seized. Under these circumstances it is first of all important to make sure that chloroform is given to the full surgical degree, to secure the greatest possible amount of relaxation of the uterus. Next there are two expedients which will almost always overcome the difficulty. The first is to find means of applying more powerful traction to the leg than can easily be exercised with the finger; the second is so to apply this traction that room is left in the vagina for the hand to push up the shoulder, and thus bring two forces to bear simultaneously on the opposite poles of the trunk. The best means of making traction on the leg is the use of a small blunt hook, as recommended by Dr. Braxton Hicks. The stem of the instrument is made of sufficiently soft metal to allow it to be bent, if necessary, to suit the curve of

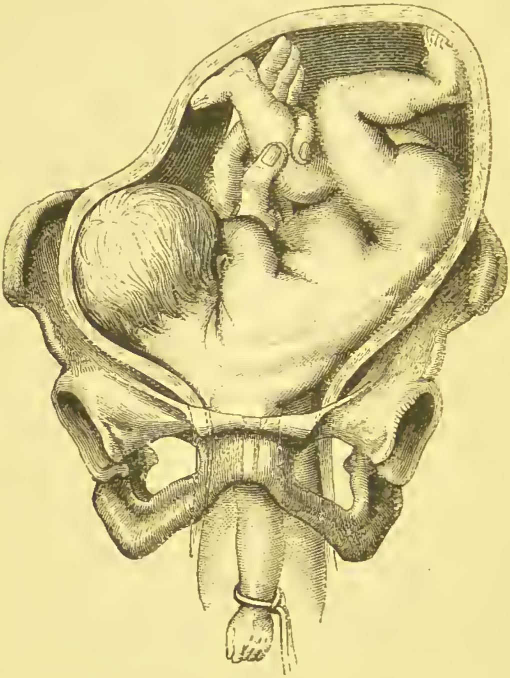

Fig. 239.—Version by the nearer leg, or that corresponding to the presenting shoulder. Noose placed upon prolapsed arm.

the genital canal, or the direction in which it has to be passed. The diameter of the hook is about one inch. The handle of the hook is held in the right hand. As the left forefinger holds the knee, the hook is passed up under cover of the arm and hand, with its flat side against the fœtus. When the knee is reached the handle is turned, so as to fix the hook across the flexure of the knee, the point being directed inwards. The finger makes sure that the point of the hook is clear of the knee on the inner side, so as not to injure the popliteal space. Very powerful traction can then be made upon the leg with the right hand. The left hand may be used to prevent the leg becoming extended, or since the stem of the hook occupies scarcely any space in the vagina, the left hand may be used to push up the shoulder, while the right hand draws down the knee. In this case the traction of the hook sometimes may cause extension of the leg and descent of the foot. If this happens, it will be necessary to remove the hook, and place a noose of tape over the foot.

TAPE

If a small blunt hook of the kind here described is not at hand, the foot should be brought down as low as possible, a noose of rather broad tape should be placed over it, and traction made upon the tape with the right hand, while the left hand pushes up the shoulder. If the fœtus will not rotate when pressure and traction are made simultaneously, it sometimes answers better to push up the shoulder with one hand, and pull down the leg with the other, alternately. A little is gained at each repetition of this manœuvre. Various devices have been suggested to facilitate the application of the noose when it is found difficult to fix it over the foot with the fingers. Most instruments for this purpose consist essentially of a long rod with a hole at the end of convenient size for passing a loop of tape through. A convenient implement is a tube of soft metal about sixteen inches long, large enough to allow a loop of tape to be passed through it. The loop is made to project at the end of the tube, is passed up into the uterus by the aid of the tube, and guided over the foot by the fingers of the left hand. The tape is then drawn up until the foot is held firmly enough, but not too tightly, against the end of the tube. The ends of the tape are then tied over a cross piece of wood at the lower end of the tube, and tube and tape together used for traction.

In the absence of such a noose-carrier, a loop of tape may be carried up and passed over the foot by means of a funis repositor, or a large gum-elastic catheter with stylet, used like a funis repositor. When the loop is drawn up tight enough, the tape and catheter are held together side by side, and traction made with them.

In very difficult cases the second leg should be brought down, noosed, if necessary, and traction should be made on both legs together. This is especially useful if the fœtus has been dead for some time, and is macerated and softened, for under such circumstances a single leg may sometimes be torn away from the trunk. If the half-breech begins to enter the os, and the shoulder still will not recede, the plan may be tried of making traction mainly on the leg diagonally opposite to the presenting shoulder, in order to elevate the shoulder by rotating the fœtus on its longitudinal axis, as proposed by Sir James Simpson; for, although the half-breech and shoulder of the same side cannot generally become jammed together in the os, this may happen if the fœtus has been long dead, and has lost all tonicity.

The treatment to be adopted if version is found altogether impossible has been already considered (see pp. 487—490). Such cases will be found of extreme rarity if the methods above described are fully carried out.

CHAPTER XXXV.

CRANIOTOMY AND EMBRYOTOMY.

UNDER the head of Craniotomy are generally included, not merely the perforation of the head, but the means required for extracting it after perforation.

Indications for the operation.—The various conditions calling for craniotomy have already been detailed. The chief of them are—great disproportion between the head and the pelvis, obstruction caused by tumours, or by cancer of the cervix ; in rare cases obstruction due to rigidity of the cervix, inflammatory deposits or cicatrices ; also dangerous conditions of the mother, such as eclampsia, calling for rapid delivery, when the use of forceps or version is not sufficient to meet the case.

On the Continent practice has been influenced by the dictum of the Romish Church that it is not lawful to destroy the fœtus to diminish the risk, or even to save the life of the mother. In this country the interest of the mother has always been considered paramount. The operation, however, stands on a different footing when the fœtus is dead and when it is alive. If there is clear evidence of the death of the fœtus, craniotomy should be performed whenever it renders extraction in any degree easier or less perilous to the mother. While the fœtus is alive the operation is only justifiable if delay or attempts to extract by other means involve a material and undoubted increase of risk to the mother. When the operation has once been decided to be desirable, it should be performed without delay. To wait for the previous death of the child greatly increases the danger to the mother, and gains only a sentimental benefit.

Mortality.—In cases of extreme pelvic contraction, or obstruction by tumours, craniotomy is a dangerous operation, as already explained. In the easier cases, in which it comes into competition with extraction by forceps or version, it involves little risk to the mother, provided that it is performed early. If danger arises, it is generally due to previous delay, or to attempts to extract the undiminished head.

In the Guy's Hospital Charity (1863—1875) the mortality after craniotomy amounted to 6 out of 18 cases, or 33·3 per cent. But the proportion of craniotomy cases, 18 in 26,591 deliveries, or 0·7 per 1,000, is a very low one, showing that the operation was only resorted to in extreme cases. The proportion of deaths after craniotomy per 1,000 deliveries is thus only 0·23. In the interval between 1833 and 1854, in which craniotomy cases were about five times as frequent in the Guy's Hospital Charity—namely 3·5 per 1,000—the total number of deaths after delivery by forceps, version for obstructed labour, or craniotomy per 1,000 deliveries was 0·57 per 1,000. The corresponding proportion was 0·50 per 1,000 in the interval 1863—1875. Thus the extensive substitution of extraction by forceps or version for craniotomy was associated with rather a diminished than an increased mortality to the mothers. In the ten years 1875—1885 there were 24 cases of craniotomy in 25,489 deliveries. There were 4 deaths, or 16·6 per cent., including one case in which the uterus was ruptured before the craniotomy.

Instruments for perforation.—The perforators chiefly used in this country are modifications of the original scissors of Smellie. These had points like the modern perforator (Fig. 240, p. 675), but handles like ordinary scissors, and the whole instrument was less powerful. The best forms of perforator are Oldham's (Fig. 240) and Simpson's (Fig. 241). With the former the hand, placed between the handles in holding the instrument, as shown in Fig. 242, p. 676, keeps the points together. With the latter the palm of the hand is pressed against the spring, which joins the ends of the handles and keeps the points from separating. Of the two, Oldham's perforator gives the more powerful hold. The points should be sufficiently sharp to penetrate the head readily, yet not so sharp as easily to prick the fingers or the vagina. When the points are closed, the handles should not be too far apart to allow them to be brought together by the fingers of one hand. The point of Simpson's perforator is sometimes made curved, to allow it more easily to be placed at right angles to the head, but it is preferable to have the point in the line of the handle, in which line pressure has to be made.

In Germany a trephine perforator has been much used. The object is to cut a clean round hole out of the skull, so that the hole is not likely to close, or fragments of bone to project. It cannot, however, be used so easily and quickly as the English perforator, and has the great disadvantage that it cannot conveniently be used to perforate the after-coming head. Moreover, it is not found practically that, after the use of the ordinary perforator, the hole does close up, or angles of bone do project.

Condition of cervix.—It is not absolutely necessary for the operation that the cervix should be fully dilated. There should, however, be room for the separation of the points of the perforator without danger of lacerating the edges of the cervix, and also for the introduction of instruments for the subsequent extraction of the fœtus. If the cervix is too small to allow this, it should be previously dilated, either by the hydrostatic dilators, or by the hand introduced in a conical form, with the aid of an anæsthetic.

Method of operating.—An anæsthetic is not absolutely necessary, but it facilitates the operation, and spares the feelings of the patient. It should be used, at any rate, in all difficult cases. Bladder and rectum should first be emptied. The hips should be brought quite over the edge of the bed ; the bed should be protected by a mackintosh, hanging down over the edge, and a footpan should be at hand to catch the evacuated brain substance.

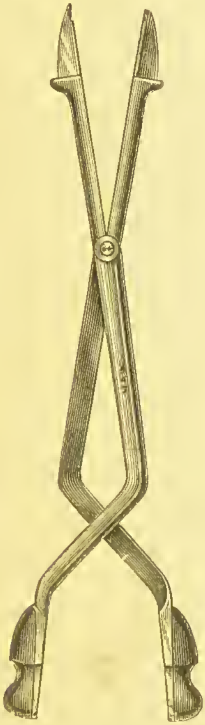

Fig. 240.—Oldham's perforator.

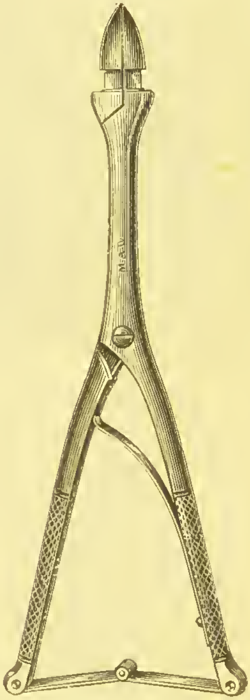

Fig. 241.—Simpson's perforator.

The spot on the head chosen for perforation should be near the centre of the presenting part, as far away as possible from the margin of the os or other soft parts. The perforation should be made through the anterior parietal bone, and not on a suture or fontanelle ; for in the latter case the bones may be simply separated and not broken through, and may close together again when the perforator is withdrawn, not leaving a sufficiently free opening for the evacuation of the brain matter.

The left hand is passed into the vagina so that the fingers rest upon the spot to be perforated. An assistant should make counter-pressure over the uterus, so as to press the head firmly down into the brim and keep it steadily fixed there. The perforator is held in the right hand, in the manner shown in Fig. 242, the palm of the hand being between the handles. It is passed up to the head under cover of the left hand, the point being kept close against the hand. As soon as the head is reached the handle is carried backward, so as to make the point impinge upon the head in as perpendicular a direction as possible. The point is forced into the head by a combination of pressure and boring or screwing movement until the bones are felt to yield. The perforator is then pushed gently on until the shoulders, which terminate the cutting portion, are level with the scalp. The handles are now approximated by the thumb and fingers of the right hand, so as to separate the points, and make a free opening in the skull. The fingers of the left hand are meanwhile kept upon the blades, at the points where they enter the scalp, to make sure that the soft parts are not endangered. The points are then closed again, the instrument is rotated on its axis through a right angle, and the points are again

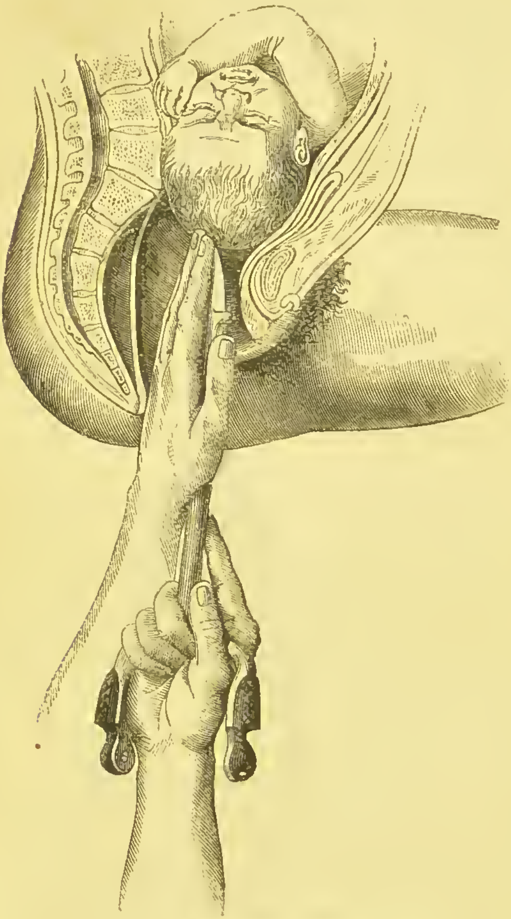

Fig. 242.—Perforation of head.

separated in a direction at right angles to the first. In the case of a greatly flattened pelvis, it is better to choose for the two directions the two oblique diameters of the pelvis, since these afford more room than the conjugate diameter.

The skull having been thus freely opened, the perforator is closed and passed on through the opening into the cavity of the skull, in order to break up the brain substance in all directions. It should especially be passed down to the foramen magnum, to destroy the medulla oblongata. The use of any force, such as might risk the point of the perforator being passed through the skull on the opposite side, must of course be avoided. The object of destroying the medulla is to make certain that the child will not cry or breathe after being delivered with a crushed head, and so distress the mother or friends. It is apt to cry if delivered quickly, notwithstanding the destruction of the main part of the brain, provided that the medulla oblongata is intact. Hence it is well, for the same reason, to wait a few minutes after breaking up the brain before beginning the extraction.

It is recommended by some to pass a tube into the cranial cavity and wash out the brain substance with a stream of water. This is not essential in easy cases, but should be done whenever much difficulty is anticipated ; for the whole of the brain substance is not evacuated either by the pressure of the pelvic walls in extraction, or by that of crushing instruments. That brain substance which remains resists the collapse of the head, or bulges it out at each side of the tract compressed between the blades of the cephalotribe.

METHODS OF EXTRACTION.

The cephalotribe.—The cephalotribe is designed to act both as a crusher and extractor of the head. The requirements of a good instrument are—first, that it should be sufficiently strong not to yield in the slightest degree under the powerful force exerted by the screw which approximates the handles ; secondly, the width across the blades should be as little as possible when they are closed, that the instrument may be capable of dragging the head through a greatly flattened pelvis; thirdly, the blades should be able to hold the crushed head without slipping ; for this purpose the blades are generally made with somewhat incurved ends, and with transverse serrations on the inside. Fourthly, the instrument should be so shaped that it can be applied with ease. For this purpose, it must be as long as the long curved forceps, that it may be able to seize the head when arrested quite above the brim, and it should have some degree of pelvic curve, like that of the long curved forceps. It is better, however, to have the pelvic curve made somewhat slighter than that usual with long curved forceps. The instrument can then more easily be rotated through a quarter of a circle, in order to bring the flattened head through the brim of a flattened pelvis. The instrument then becomes virtually straight, as regards its relation to the curve of the genital canal. If it had a strong pelvic curve, the ends of the blades would be liable to injure the lateral wall of the pelvis.

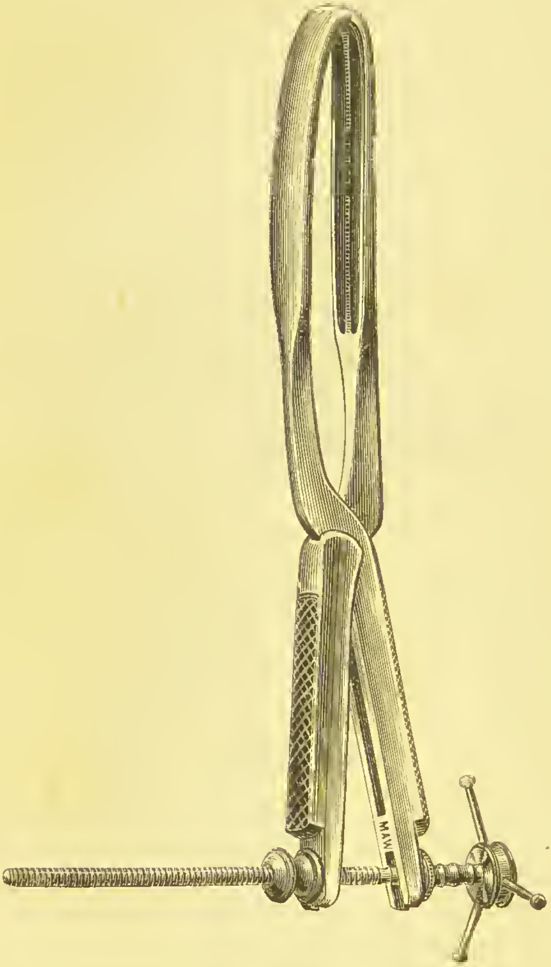

Fig. 243.—Braxton Hicks' cephalotribe.

A form of cephalotribe much used is that of Dr. Braxton Hicks (Fig. 243). The blades are nearly parallel when the instrument is closed, but incurved at the ends. The pelvic curve is not greater than about 20° in all, so that, when the instrument is laid flat upon a table, convex side downward, the ends of the blades are not separated from the table by more than about an inch. When the instrument is closed, the width across the blades is not greater than $1\frac{3}{8}$ inch. The form of screw shown in Fig. 244, p. 681, is more convenient for the fingers than the original pattern, as shown in Fig. 243. It would be still more convenient to have the screw attached by a hinge to the lower blade. The lock is of the

English form, and therefore more easy to adjust than that of foreign instruments.

Cases suitable for the cephalotribe.—In all ordinary cases of craniotomy, extraction can be effected by the cephalotribe more easily and rapidly than by any other means, and with less chance of any angles of bone projecting and injuring the soft parts. It is therefore an instrument which all practitioners will find it worth while to possess. When, however, the child has to pass through an aperture narrowed in all directions, as in the case of the pelvis æquabiliter justo minor, or a cervix contracted by cancer or by cicatrices, the head, flattened in the grasp of the cephalotribe, has an unsuitable shape for passing when the contraction is great. Since the breadth across the blades when the instrument is closed is only $1\frac{3}{8}$ inch, the head may, under the most favourable circumstances, be brought by the cephalotribe through a space measuring only $1\frac{1}{2}$ inch in its smallest diameter, provided that the transverse diameter bisecting this smallest diameter measures as much as somewhat over 3 inches. It follows that extraction may sometimes be effected by the cephalotribe in quite as high a degree of contraction in flattened pelves as by any other possible means. For this result, however, it is essential that, while the blades grasp the head pretty centrally, the extremities of the blades should be free on the other side of the head, and capable of meeting, as in Fig. 244, p. 681. If the neck, or thorax, or part of the head intervenes between the ends of the blades, the instrument cannot be closed so completely, and will not pass through so small a space.

It is frequently a difficult matter to succeed in applying the cephalotribe centrally over the head, in such a way that the instrument can be completely closed. Hence, in extreme forms of pelvic contraction, other modes of extraction shortly to be described come into competition with the use of the cephalotribe, and may sometimes succeed when the cephalotribe has failed.

The diminished pelvic inclination usually found in the flattened rachitic pelvis facilitates the use of the cephalotribe; an increased pelvic inclination renders it more difficult, when contraction is extreme, especially as compared with the method of induction of face presentation after cranioclasm (see p. 687).

Method of operating.—The blades are to be passed at the sides of the pelvis, without regard to the position of the head. Generally the head is caught somewhat diagonally, as by the blades of forceps; but if the head is above the brim in a flattened pelvis, it is very likely to be caught by the two blades over forehead and occiput, as shown in Fig. 244, and this is the most favourable way of seizing it. As with the ordinary forceps, the lower blade is to be passed first.

The fingers of the left hand are passed into the vagina and within the cervix, and the blade guided up just like the blade of forceps. The second or upper blade may, like the upper blade of forceps, be at first passed up opposite the sacro-iliac synchondrosis, the handle being carried forward between the thighs, and the blade afterwards swept round to the right of the pelvis by carrying the handle downward and backward. The blade does not, however, glide laterally over the head so easily as that of forceps, on account of the serrations on its inner margin, and its incurved extremity. Hence, if it is found difficult, by this mode of introduction, to get the blade exactly opposite to the lower one, it is better to pass it at once up the side of the pelvis, having the patient quite at the edge of the bed, and depressing the handle strongly. Both blades should be passed on until the whole of the serrated portion of their inner surface is out of reach, lying against the head (see Fig. 244).

In order to adjust the lock, the handles should be pressed back against the perineum, somewhat more than those of forceps, so that the blades, with their pelvic curve slighter than that of forceps, may seize the head centrally. The screw is then applied, and before it is tightened the left hand makes sure that the blades are at opposite sides of the head. If they are too near together, either at the back or the front of the pelvis, they will slip either backward or forward off the convexity of the head as the screw is tightened. The instrument is then screwed up as tightly as possible. The operator should first have noticed how nearly the handles approximate when the instrument is completely closed, and should endeavour to screw them up as nearly as possible to this position; for if the inner surfaces of the blades are divergent instead of parallel or nearly so, the instrument is liable to slip off when traction is made. As the screw is tightened, the brain substance will be squeezed out, if it has not previously been washed out with a stream of water. When the crushing is completed, the left hand should be passed up again to feel whether the blades have slipped off, or are grasping the head centrally. There will now be room to pass the hand further into the uterus, to make out their exact position. The operator should also make sure that there are no projecting angles of bone at the point of perforation. If any are found the pieces of bone should be pulled away with the fingers or small craniotomy forceps (see Fig. 246, p. 683), or the angles should be nipped off with a pair of bone-nipping forceps, which are a useful adjunct to the obstetric bag. Generally it will be found that, if the head is properly grasped, the angles of bone are covered by the scalp, as shown in Fig. 244, or are shielded between the shanks of the instrument.

If it is found that the blades have slipped more or less off the head, backward or forward, the screw should be loosened, and the blades reapplied more centrally. There will now be probably room to pass the hand up into the uterus by the side of the head, in order to adjust the position of the blades. The crushing is then repeated. In a difficult case it may be necessary to repeat this process several times in succession, before a sufficiently central grasp is secured. It is more dangerous to make traction when the blades are rather in front of the centre of the head (in reference to the pelvis) than when they are rather behind it as in Fig. 244; for, in the former case, the tips of the blades are liable to project and injure the soft parts.

Supposing that a sufficiently central grasp has been secured, traction is to be commenced. If the head is already in the cavity of the pelvis, or if the pelvis is uniformly contracted, the cephalotribe is to be drawn down in the position in which it was applied. If, however, the pelvis is flattened, and the head is still above the brim, the cephalotribe should be rotated through nearly a quarter of a circle. This will bring the long diameter of the flattened head to correspond with the transverse diameter of the flattened brim, whereas at first the head was flattened out in the direction of the contracted conjugate. In extreme degrees of contraction of the conjugate, care should be taken that the instrument is so far screwed up as to close it completely, or almost completely, before traction is begun; for it would be dangerous to make pressure upon the symphysis pubis and promontory of the sacrum by the diverging blades of the instrument itself. Traction must be made in a direction as much backward as possible, until the head has passed

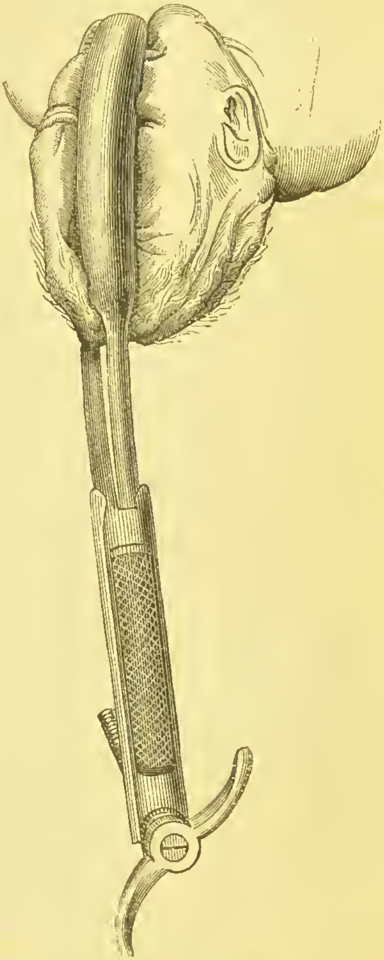
Fig. 244.—Head crushed by cephalotribe.

the brim. It will probably not be possible to pull accurately in the axis of the brim, since the advantage of the pelvic curve of the cephalotribe is now almost or entirely lost, its concavity being turned to one side. If the cervix is not at first fully expanded, ample time must be allowed for it to dilate. The hand should also be introduced from time to time to ascertain if the blades keep in position, and whether any angles of bone begin to project. Any such angles should be nipped off as before. As the head descends to the pelvic floor, traction is to be made more forward, and the cephalotribe may be allowed to rotate in any direction to which the resistances impel it. Generally it will be found that the shanks tend to rotate forward under the pubic arch, like the leading portion of the presenting part of the fœtus, and thus the cephalotribe passes the pelvic outlet with its concavity directed *backward.* It has thus been rotated through half a circle in all. It will most commonly be found that the hard base of the skull has not been broken up by the cephalotribe, but tilted in the grasp of the blades, either laterally or longitudinally. It is best for the base of the skull to be tilted into a position of flexion, as shown in Fig. 244, because then the maximum diameter of the flattened head does not much exceed the transverse diameter of the base of the skull, or about 3 inches.

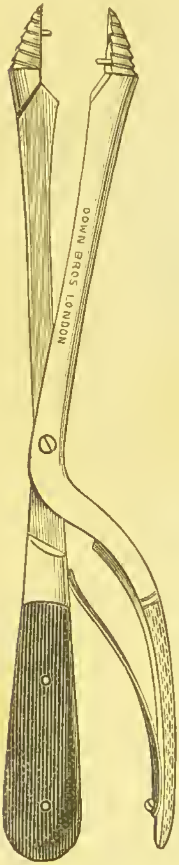

Fig. 245.—Simpson's Splitting Basilyst.

In general the tilting of the base of the skull is quite sufficient, and there is no necessity for breaking it up. Such breaking up could only be useful when transverse diameter as well as conjugate is much contracted. An instrument for the purpose, the basilyst, has been introduced by Professor A. R. Simpson of Edinburgh. It is first screwed into the base of the skull, and the blades then separated. The cephalotribe may be applied afterwards.

Craniotomy forceps.—Craniotomy forceps may be used in two totally different operations, which should be carefully distinguished from each other by the student. In the one, the instrument is used simply as a tractor, the diminution in the size of the head being effected by the pressure of the pelvis. In the other, it is used to break off and tear away pieces of the vault of the skull, and so reduce the size of the head. This operation is called *cranioclasm.* That form of craniotomy forceps which has a screw to approximate the handles may be put to yet a third use, under exceptional circumstances, as when a face presentation is induced after cranioclasm, namely, to crush the remnant of the head.

Varieties of the instrument.—The simplest form of craniotomy forceps is that in which the blades are hinged, as in Fig. 246. This may be used as a tractor, the smaller blade being passed into the skull through the opening made by the perforator, the larger one outside the scalp, so that the curvature of the blades corresponds to the curvature of the head. It may also be used to break away pieces of the skull in cranioclasm. The fenestra in the larger blade allows a firmer hold of the head to be taken when the instrument is used as a tractor.

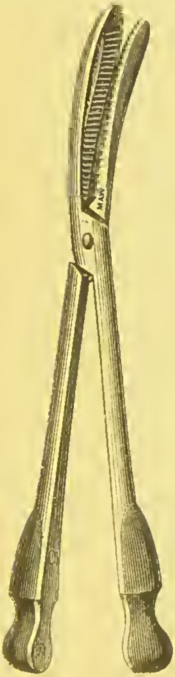

Fig. 246.—Craniotomy forceps. Simple form.

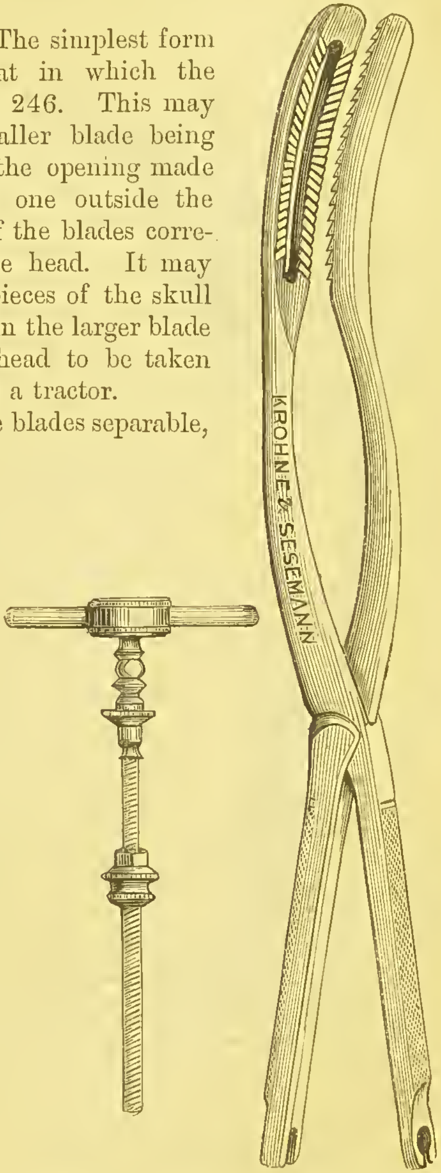

Fig. 247. Roper's craniotomy forceps.

Sir James Simpson made the blades separable, and united by a lock similar to the French forceps lock. The instrument so produced he called a cranioclast, though it is more adapted for use as a tractor than as a crusher. Two modifications of this instrument are almost identical with each other. One is Braun's cranioclast, much used in Germany; the other Barnes' craniotomy forceps. Both these are adapted chiefly for use as tractors, and in both the handles are approximated by a screw. This is a great improvement, since it enables a very firm hold to be maintained without fatigue to the hand, and also allows the instrument to be used for crushing, if desired. There is a still further improvement in Roper's craniotomy forceps (Fig. 247). The lock in these is the English lock, and is therefore easier to adjust, and it is nearer to the handles. It is thus always outside the vulva, and can be adjusted without any risk of nipping the mucous membrane. The instrument is so made that the same screw can be used for it as for Hicks' cephalotribe. It would be preferable to have the screw attached by a hinge to the handle of the solid blade.

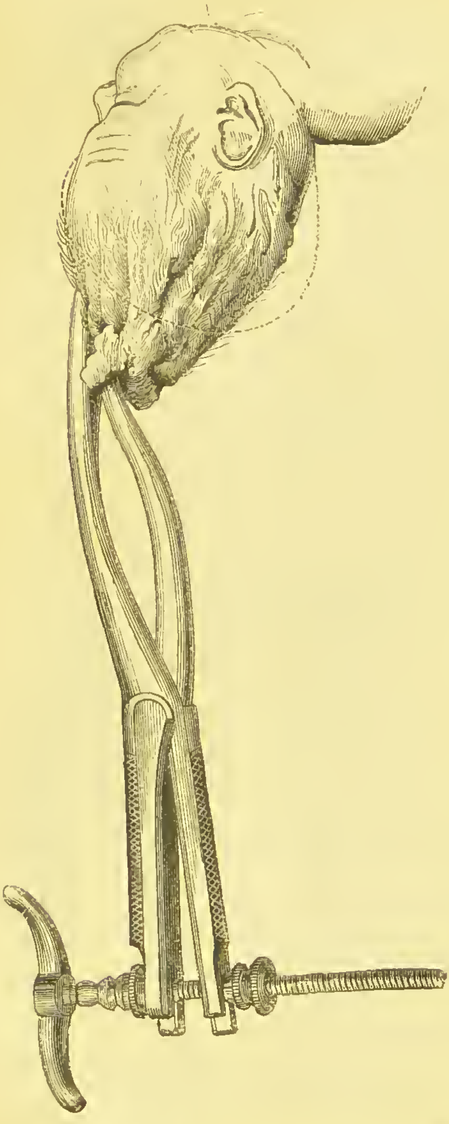

Fig. 248.—Elongation of head in conical form by extraction with craniotomy forceps.

Cases suitable for extraction by craniotomy forceps.—There has been much controversy as to the relative merits of extraction by cephalotribe or craniotomy forceps (the so-called cranioclast). On the Continent, where the cephalotribes chiefly in use are very large and formidable instruments, the craniotomy forceps have found favour with many, being considered to involve less risk of injury; but a cephalotribe such as that of Hicks' will be found safer as well as easier to use in all ordinary cases ; for since the craniotomy forceps grasp only the vault of the skull, and not the whole head so completely as the cephalotribe (see Fig. 248), they are more likely to tear away the bone, when there is much resistance, and so cause dangerous angles to project.

The cases specially suitable for the use of craniotomy forceps are those in which the space is contracted in all its dimensions, so that the head flattened out in one direction in the grasp of the cephalotribe cannot find any diameter large enough to admit its greatest diameter. This may occur in the pelvis æquabiliter justo minor, and also when the whole circuit of the cervix is involved in cancer. The mechanism by which the use of craniotomy forceps is then specially advantageous is the following :—The head is elongated in the direction of the pelvic axis by the traction, and at the same time is crushed in all other directions by the pressure of the pelvic wall or cervix, so that all its other diameters are reduced in almost equal proportions. This is illustrated in Fig. 248, p. 684, in which the dotted line indicates the original outline of the head. If, however, the cephalotribe is applied in the most favourable possible way, so as to tilt the base of the skull into a position of flexion as in Fig. 244, p. 681, it is not found practically that the diameter at right angles to the compressed one is enlarged by the pressure ; and in such case the cephalotribe is equal or superior to the craniotomy forceps, even for extraction through a uniformly contracted opening ; the maximum diameter in either case being the transverse diameter of the base. In the absence of the cephalotribe, craniotomy forceps are the best instrument for extraction in other cases also.

Mode of using craniotomy forceps as a tractor.—The left hand is passed into the vagina, and the fingers placed upon the aperture in the skull. The solid blade of the craniotomy forceps is taken first, and guided by the fingers of the left hand into the aperture, so that it passes into the interior of the skull, underneath the bones. The object should be to seize, not merely the parietal, but the occipital or frontal bone, since the parietal bone more easily tears away from the base of the skull. The serrated surface of the blade should therefore be directed toward the side of the pelvis where the occiput or forehead lies, and the blade should be pushed into the skull as far as it will go, so that as much as possible of the bone may be secured. Of the two bones the occipital is preferable, because traction then promotes flexion of the head ; but, if the occiput is directed forward, the frontal bone is easier to seize, because the outside blade is more easily passed up at the posterior part of the pelvis. The fenestrated or external blade is next taken, and passed up *outside* the scalp, in such a direction as to correspond to the other blade. The depth to which it should be passed must be regulated by the position of the other blade, so that the lock may be adjusted. The instrument is then screwed up as tightly as possible, and traction made in the pelvic axis. Frequent examinations must be made, to see whether the instrument is slipping, or any angles of bone beginning to project. Such projecting angles must be nipped off. If the force of traction which can be exerted by one hand is found sufficient, it is well to keep the left hand constantly in the vagina, to watch the progress. If the instrument slips, or the main portion of bone which it is holding tears away, it must be unscrewed and reapplied, if possible in such a way that its grasp extends more deeply. If the pelvis is flattened and the occipital bone has been seized, so as to secure extreme flexion of the head, it is sometimes advantageous, if the head does not easily pass, to rotate the instrument so as to bring the transverse diameter of the head into the transverse of the pelvis. Unless this is done the width of the base of the skull, about three inches, is the limit to the size of conjugate through which the head can be brought. But the antero-posterior diameter of the extremely flexed skull may be reduced by pressure of the pelvic wall somewhat below this.

Cranioclasm.—The operation of cranioclasm is much more difficult and tedious than extraction by the cephalotribe or craniotomy forceps. It also involves risk of injury both to the soft parts and to the operator's fingers by the angles of detached bone. It should only be undertaken, therefore, in those cases of extreme difficulty in which the operator cannot effect extraction by one of the two former methods without exerting a dangerous degree of force.

Method of operating.—The best instrument for removal of pieces of bone is a pair of craniotomy forceps, such as those shown in Fig. 246, p. 683 ; or, still better, one in which both blades are solid without fenestra. The instrument is passed up to the head under the guidance of the left hand in the vagina. One blade is passed between the cranial bones and the scalp, the other through the aperture into the interior of the skull. If possible the instrument should be so passed that its curve corresponds to that of the head, for then it is likely to secure a larger piece of bone ; but if it is found easier to turn it the reverse way, and pass the other blade between the bone and the scalp, there is no objection to doing so. The bone is then grasped, and a sudden twist, first in one direction, then in the other, is given to the instrument so as to break the piece of bone in its grasp away from surrounding parts. The forceps are then twisted round and round till the piece of bone is entirely detached, and finally the piece is drawn out, covered by the left hand, and so prevented from lacerating the soft parts. The piece of bone should be in the palm of the hand, *the fingers closed over it, so that it is brought down within the closed fist*, and cannot possibly touch any soft parts. This process is to be continued, until nearly the whole of the vault of the skull has been removed, including the whole of the parietal bones. The student must take care to remember that *in cranioclasm the outer blade is passed between the scalp and the bone, but that, when craniotomy forceps are used as a tractor, it is passed outside the scalp.*

Induction of face presentation.—When the vault of the skull has been broken up and in great part removed, the best way to deliver the head in a greatly contracted pelvis, especially one with a very small conjugate diameter, is to induce face presentation. If the chin be brought to the front, the diameter opposed to the conjugate is then only the vertical diameter of the face, little more than 1 inch, and that opposed to the transverse is the bimastoid or bizygomatic diameter, not more than 3 inches. The face may be brought to present by the small blunt hook already described as useful for securing the knee in version (see p. 670). The hook is fixed first into the orbit, and then, after the orbit has been brought down, upon the chin, or some part of the lower jaw near it. The chin having been completely drawn down, so that the face presents, delivery may be completed in one of two ways. The blunt hook may be transferred to the inner surface of the base of the skull, be fixed into some of the projections of bone there, and so draw the head down; or the craniotomy forceps with a screw at the handle (Fig. 247, p. 683) may be used. This is the only condition in which this instrument can be used with advantage as a crusher as well as a tractor. The solid blade is passed in front of the chin, the fenestrated blade over the base of the skull, and the screw tightened as much as possible. Thus the small vertical diameter of the head which remains is still further compressed. This method of delivery is most useful when the vault of the skull has not been completely removed. In the absence of the small blunt hook, the crochet (Fig. 249, p. 688) may be used in its place in this operation. This method of delivery is the best adapted of any to overcome extreme conditions of contraction, affecting transverse as well as conjugate diameter; for the base of the skull is brought down in its most favourable position, which it will not always be when tilted in the grasp of the cephalotribe.

Version.—Version is sometimes performed to facilitate delivery after craniotomy. In the extraction of the after-coming head, the skull collapses under the pressure of the pelvis, and the bones generally remain covered by the scalp. Version may be performed with advantage in the absence of an efficient cephalotribe or craniotomy forceps, or if the operator does not succeed with either of these instruments, when the degree of contraction is not very extreme. In very extreme contraction, the extraction of the body might cause difficulty, owing to the extension of the arms. In such cases it is preferable to perform cranioclasm, and then induce face presentation.

Secondary Symphysiotomy.—When it proves impossible to extract after craniotomy without a dangerous amount of traction, space may be gained by secondary symphysiotomy. The same operation may be chosen in preference to the prolonged and difficult operation of cranioclasm. Symphysiotomy has however a less favourable influence on the pelvic diameters in extreme contraction of the conjugate, than it has when general contraction forms a main part of the difficulty.

The Crochet.—The crochet (Fig. 249) was the instrument formerly most used for extraction after craniotomy. The crochet is passed through the aperture into the interior of the skull, and fixed against any part of the vault of the skull where it can obtain a firm hold.* The fingers of the left hand are placed on the outside of the scalp, opposite the point of the crochet and pressing against it, and then traction is made. The disadvantage of this proceeding is that the crochet is apt to slip, or to tear away the piece of bone which it is holding, and so cause laceration. This mode of extraction should not therefore be adopted if any better one is available. The crochet is, however, often very useful in the extraction of a dead fœtus, when fixed into any available part of the body, in order to secure a hold for additional traction. The small blunt hook may be used in the same way.

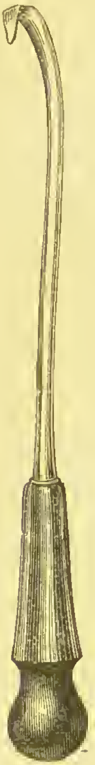

Fig. 249.—Crochet.

Division of the head.—Various modes have been devised for cutting up the head by chain saws and other means. Barnes has proposed to divide it into sections by a strong steel wire écraseur, but this method has not been recorded as having been carried out in actual practice. All these proceedings are difficult to execute in cases of extreme contraction, and it is doubtful whether, in a pelvis through which the head could not be delivered by cranioclasm and induction of face presentation, it would be possible to deliver the body without very great risk to the mother. Cæsarian section would in general be preferable.

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* Students often say at an examination that the crochet should be fixed in the foramen magnum. This, however, is impossible, since it is much too large. The only instrument which could be fixed in the foramen magnum is the vertebral hook invented by Dr. Oldham for extraction of the after-coming head.

Forceps.—Forceps should never be applied to deliver the head after craniotomy, because they are liable to slip off as the head collapses. Foreign forceps in which the points are close together when the handles are closed, may succeed in easy cases, but the ordinary English forceps are of little use for this purpose.

Extraction of the body.—As a rule, it is only when contraction is extreme, or the child very large, that extraction of the body meets with much difficulty. The cephalotribe or craniotomy forceps should be kept applied to the head to furnish a good hold for traction, until the thorax has passed the brim. If much resistance is met with, the crochet or small blunt hook may be fixed in one axilla, so as to draw down one shoulder in advance of the other. If this does not answer, both arms may be drawn in front of the chest by the same means, and used to afford an additional hold for traction. The perforator may be used to pierce the chest and abdomen, but not much is gained by this, unless the abdomen has become distended by decomposition. If necessary, the cephalotribe may be applied over the chest, and afterwards over the pelvis, especially if the head should have separated and come away from the trunk under traction.

Perforation of the after-coming head.—In the case of the after-coming head, the usual method of craniotomy has been to perforate behind the ear, or through the occipital bone. This has the disadvantage that the point of the perforator impinges on the skull at a very acute angle, and is very close to the maternal soft parts. An improved method has been introduced, namely, to perforate through the roof of the mouth. The blades can then be separated in two directions at right angles, as in the case of the fore-coming head. If the head has become at all extended, care must be taken to direct the point of the perforator somewhat backward toward the occiput, otherwise it may only enter the orbit, and not the cavity of the skull. In one respect there is an advantage in this method even over perforation of the fore-coming head, namely, that the base of the skull is more or less broken up. For this reason Dr. Archibald Donald, of Manchester, has advocated preliminary version in all difficult cases of craniotomy ;* but this advice has not been generally accepted.

After perforation through the roof of the mouth, the brain substance should be broken up with the perforator, and then washed out with a stream of water. In easy cases the head can be extracted by traction. In difficult ones, the body of the child should be held forward by an assistant, while the blades of the cephalotribe are applied at the sides of the pelvis. When a central hold has been obtained of the head, the instrument should be rotated through a quarter of a circle, in the case of a flattened pelvis, and so drawn down.

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* Obstet. Trans., Vol. XXXI.

Embryotomy in pelvic presentations.—It is only in cases of extreme disproportion that the body of the child cannot be brought through the brim in pelvic presentations, or after version. Sometimes, however, the pelvis of the child refuses to enter the pelvis of the mother, and the difficulty is then greater than in head presentations. The alternative of performing Cæsarian section or symphysiotomy, before much effort is made at traction, then arises. If this is rejected, both legs should be brought down, and traction should be made upon them, both together and separately, in order to find out the best way of bringing down the child's pelvis. If the child is dead this may be aided by the crochet or small blunt hook fixed over the pelvis. If the abdomen of the child has become distended, after death of the fœtus, it may be necessary to perforate it.

The methods of performing embryotomy in shoulder presentations, when version is impossible, have already been described (see pp. 487–490).

For severely contracted Pelvis
Vie [illegible]

CHAPTER XXXVI.

SYMPHYSIOTOMY, CÆSARIAN SECTION AND LAPARO-ELYTROTOMY.

SYMPHYSIOTOMY.

History.—The first recorded case of symphysiotomy was performed by Jean Claude de la Courvée in 1644. A better known case was one in which the operation was performed by Sigault and Le Roy in 1777. The result was not very satisfactory; for a vesical fistula formed, and the bones did not unite. The operation did not therefore find general favour, but Italian operators continued to perform it from time to time. Between 1777 and 1849, 65 cases were recorded in Italy, with a maternal mortality of 32·4 per cent. and a fœtal mortality of 64 per cent. It was taken up more actively in Italy in 1866, chiefly by Morisani and Novi of Naples. From 1866 to 1881, 50 cases were recorded, with a maternal mortality of 20 per cent. and a fœtal mortality of 18 per cent. Between 1881 and 1885, however, the maternal mortality increased to 44 per cent. Of late years the mortality has greatly diminished, probably in consequence of antiseptic improvements in surgery. 52 more recent Italian cases give a maternal mortality of 2 per cent. and a fœtal mortality of 13·4 per cent.*

Since 1891 the operation has been warmly advocated by Pinard of Paris, and a considerable number of cases have been performed in various countries. According to Harris, out of 233 operations performed in various countries in 1892–1893, the maternal mortality was 11·1 per cent., the fœtal mortality 22·7 per cent. Of these, very few were performed in Britain, the majority in Italy, France, and Germany. The result of the operation, however, under favourable circumstances, and in the hands of skilled operators, is more favourable than this: for of 19 cases in the clinique of Pinard, all the mothers were saved, and all the children born alive, 3 of the children dying within a few days.

The disfavour with which the operation was at first received is explained by the unfavourable results of the earlier cases, as regards children no less than as regards mothers. It also appeared theoretically that, in a flattened pelvis, but little increase of the sacro-pubic diameter could be obtained by dividing the symphysis. It is now recognised that the field of the operation is in moderate, not in extreme contractions of the conjugate; and that, in the puerperal pelvis, owing to the relaxation of the joints, a wider separation of the pubic bones can be safely obtained than appeared probable *à priori*, or than would be possible apart from pregnancy. Thus the central mass of the head passes in the gap between the separated pubic bones, and does not enter even the enlarged sacro-pubic diameters at all, as shown in Fig. 250.

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* See Harris, "American Journal of Medical Sciences," March, 1893.

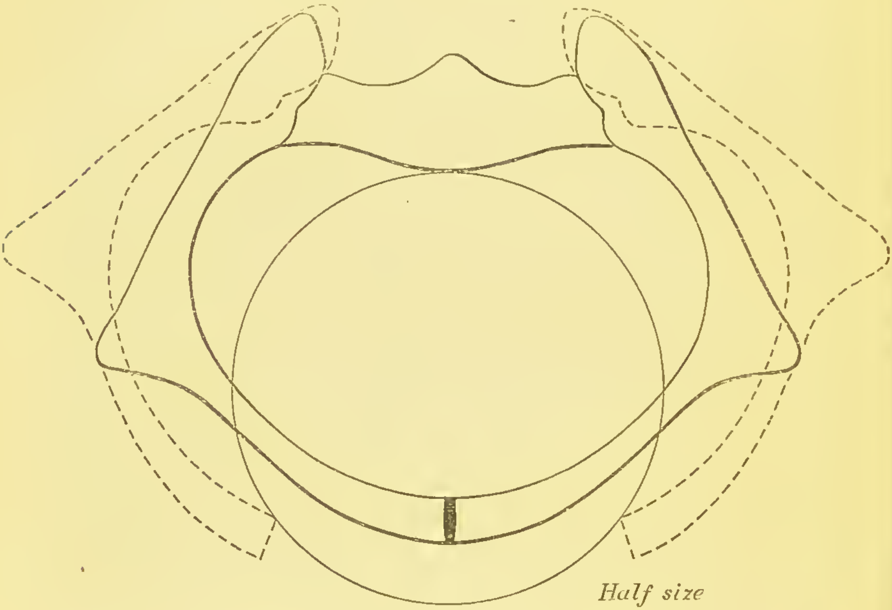

Fig. 250.—Separation of bones in symphysiotomy.

Indications for the operation.—It appears that the smallest conjugate for which the operation can reasonably be recommended is about $2\frac{3}{4}$ inch (7 cm.); although Pinard considers it available, in the simple flat pelvis, down to $2\frac{5}{8}$ inch, and I have myself performed it successfully, though with considerable laceration of vagina, with a conjugate of $2\frac{1}{2}$ inches. In Figure 250 is shown the effect of the operation in a flattened pelvis with slight general contraction, the conjugate being $2\frac{3}{4}$ inches. Allowing $\frac{1}{4}$ inch for soft parts, a circle of $3\frac{3}{4}$ inches diameter will generally be required for the passage of a full-sized fœtal head. The corresponding separation of the pubic bones, as shown in the figure, is fully

$2\frac{3}{4}$ inches, and the bones must also be separated at the anterior margins of the sacro-iliac joints to the extent of at least $\frac{1}{4}$ inch.

The operation may therefore replace Cæsarian section in a number of cases in which that operation is now performed in the interest of the fœtus. It is not a substitute for it in those cases in which it is absolutely indicated in the interest of the mother. For with a conjugate of $2\frac{3}{4}$ inch and upward, extraction after craniotomy, in the hands of a skilled operator, does not involve much risk to the mother, provided that she is not endangered by attempts to save the child. Symphysiotomy may also replace craniotomy in cases in which forceps fail to extract, in the interest of the child. Or again, it may be performed in the interest of the mother, if extraction after craniotomy proves very difficult. With this last exception, it is an operation performed in the interest of the child, not in that of the mother. In a large proportion of recorded cases, it has been performed with conjugates exceeding 9 cm. ($3\frac{1}{2}$ inches).

According to Pinard, if the pubic bones are separated 6 cm. ($2\frac{3}{8}$ inches), the distances from the sacral promontory to their ends are increased 15 mm., and the total gain, by the projection of the head through the gap, is 22 mm. or $\frac{7}{8}$ inch. Biermer* found, by experiments on puerperal pelves, that separation of the pelvic bones to distances varying from 7 to 9 cm., caused luxation of the sacro-iliac joints. Caution must therefore be used in carrying the separation beyond 6 cm. Biermer also gives the following table, founded upon similar experiments. It will be seen that he estimates the gain in the antero-posterior diameter lower than Pinard. It is also evident that the gain in the transverse diameter is much more marked, and that therefore the operation is specially suited for generally contracted pelves, in which the transverse diameter forms a main part of the difficulty.

Separation at symphysis. cm.	Increase of antero-posterior diameter. cm.	Increase of transverse diameter. cm.
2	·25	1·
3	·5	1·5
4	·65	2·
5	·83	2·25
6	1·1	3·
7	1·4	3·1

The operation appears to be followed by less inconvenience in multiparæ than in primiparæ, on account of the rigidity of the soft parts in the latter. Thus Caruso reports 22 cases, in which all the mothers recovered, and 20 children were born alive. Of 12 multiparæ all passed through a normal puerperium. Of the 10 primiparæ, 8 suffered some pathological complication, and 3 of them had vesical fistulæ.

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* Centralbl. f. Gynäk., 1892, No. 51.

Preparations.—The os uteri should be as fully as possible dilated. If the membranes have ruptured prematurely, and the head cannot descend upon the os to dilate it, being arrested above the brim, it is desirable to dilate the os with Champetier de Ribes' or Barnes' dilators. The pubes and labia majora should be shaved, and pubes and vagina disinfected with perchloride of mercury 1 in 1000. It is not a contra-indication that labour has been somewhat prolonged, provided that there has been no septic infection. If forceps are tried first, no great force should be used with them, otherwise the child's life may be endangered.

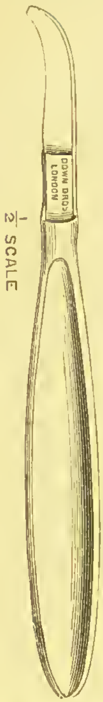

Fig. 251.—Symphysiotomy knife.

Instruments.—The instruments required are scalpels, scissors, dissecting forceps, pressure forceps, curved needles and needle-holder, sutures of silver wire, fishing gut, and of chromicised gut or fine silk, and a special symphysiotomy knife (Fig. 251), or a blunt-pointed bistoury with cutting edge to the end. It is desirable to have also Pinard's registering separator for the pubic bones, and a chain saw. There should be three assistants besides the anæsthetist, one to assist the operator, two to stand at the sides of the patient, and press the innominate bones together, when required.

The operation.—The operator stands between the patient's thighs. An incision is made about 3 inches long in the median line, commencing above the pubes, and ending just above the clitoris or inclined laterally at the side of the clitoris outside the nympha. Bleeding points are secured by pressure forceps. If there is much venous oozing, a plug of iodoform gauze may be used after the symphysis has been divided. The pyramidalis and recti muscles are then separated from the top of the pubic bones, sufficiently to allow the operator to pass his index finger behind the symphysis, and protect the bladder from the tip of the knife. The operator then seeks for the symphysis and divides it from above downwards, including the inferior ligament, with the curved blunt-pointed knife introduced by Galbiati (Fig. 251), or with a blunt-pointed bistoury, keeping the finger between the knife and the bladder. The Italian operators, however, divide the symphysis from below upward. During the cutting through the symphysis, a bladder sound should be held in the urethra, and should draw it somewhat to one side, the opposite side to that to which the cutaneous incision has been made to incline at its lower part. As soon as the division is complete, the bones generally spring apart suddenly to a distance of $\frac{3}{4}$—1 inch.

Occasionally operators have failed to divide the symphysis with a knife, and have been obliged to have recourse to a chain saw. This has probably been due, not to anchylosis, but to the operator failing to find the symphysis, which is often not exactly in the middle line.

When the symphysis has been divided, Pinard's registering separator (Fig. 252) may be introduced, to aid the separation, and indicate its amount. By eversion of thighs, and, if necessary, by traction upon the ilia, a separation of at least 4 cm. ($1\frac{5}{8}$ inch) should be obtained, before traction is commenced.

The fœtus should then be extracted by forceps, axis-traction forceps being the best for the purpose. If the indicator shows that the separation of the pubic bones reaches 7 cm. ($2\frac{3}{4}$ inches), the assistants should support the ilia at each side. If the head descends covered by the cervix, ample time should be allowed, and the rim of the cervix pushed back by the fingers. After the head has passed the brim, the assistants should press the ilia together, and endeavour to diminish the separation. Otherwise the anterior part of the vagina, unsupported by the bones, is apt to tear into the wound. Care should be taken to draw well downward toward the perineum, even at some risk of laceration to that structure, and not carry the handles of the forceps so much forward as in ordinary forceps extraction.

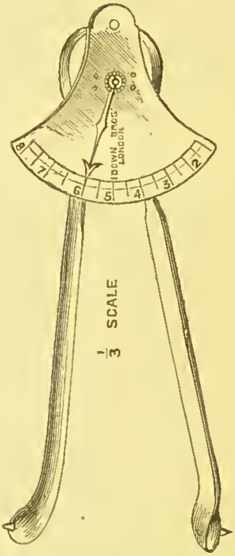

Fig. 252.—Pinard's registering separator for symphysiotomy.

Four deep silver sutures should be used to unite the tissues in front of the pubes, including the dense tissue close to the bone. I have drilled the bones and wired them together with thick silver wire, in order to secure perfectly close union without further trouble, but operators have not generally adopted this plan. The rest of the wound may be closed by fishing-gut sutures. Any laceration of vagina, bladder, or urethra must also be closed by fishing-gut or silver wire. A firm belt is placed round the pelvis, the sutures are removed at the end of a week, and the patient is kept in bed at least three weeks. After the operation, the uterus and vagina are washed out with perchloride of mercury 1 in 2000. The same or a weaker solution is used as a vaginal douche twice a day. Pinard uses a tampon of iodoform gauze in the vagina.

The dangers of the operation are laceration of the vagina, bladder or urethra. In some cases suppuration of the wound has occurred. Hæmorrhage has sometimes proved troublesome, and, in one case at any rate, has been fatal. In some cases the pubic bones have remained moveable upon each other, only loosely united by fibrous tissue. It is generally stated that the patients have not been much the worse for this ; but, upon this subject, there is not yet much experience in this country.

Cæsarian Section.

By Cæsarian section is meant the removal of the fœtus by incisions through the walls of the abdomen and the uterus. In the variety of the operation introduced by Porro it is completed by the excision of the whole of the body of the uterus.

History.—Cæsarian section is a mode of delivery which would naturally suggest itself at a rude period of surgical art. Tradition has related of several noted men of ancient days—such as Æsculapius, Scipio Africanus, Julius Cæsar—that they were delivered in this way. Although the tradition is not believed to be well founded as regards Julius Cæsar, the derivation of the title Cæsar from "*A matris utero cæsus*" has been generally accepted. Such traditional accounts are open to the interpretation that, if true at all, they refer probably in most cases only to Cæsarian section performed after the mother's death. But, even to the present day, Cæsarian section for delivery of the living woman is practised among some savage tribes in a low grade of civilisation, as in the interior of Africa.* This affords some presumption in favour of the view that the same operation may have been performed in ancient days. During the sixteenth century Cæsarian section was believed to have been performed in various instances, during the life of the mother, although no reliable histories of the cases have been preserved. The first authentic record is that of a Cæsarian section performed in a case of hernia of the gravid uterus by Trautman, at Wittenberg, in 1710. The patient lived 25 days after the operation.

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* "Notes on Labour in Central Africa," by R. W. Felkin, Trans. Obst. Soc. Edin., 1884.

Up to the last few years the mortality of Cæsarian section had been so high as to restrict the operation to those cases in which delivery through the pelvis was either impossible or so difficult as to involve very great risk to the mother. British statistics gave a mortality of about 84 per cent. The first improvement was introduced in 1876, by Porro of Pavia, who followed up Cæsarian section by the removal of the whole uterus with the ovaries in a case of pelvic contraction. Thus was introduced Porro's operation, hereafter to be described. It was practised in a good many cases of pelvic contraction with a success considerably exceeding that of the old Cæsarian section. The modern method of Cæsarian section was first suggested by Sänger in 1882. It was perfected and simplified chiefly at Dresden and Leipzig, by Leopold and other operators, and has attained such success as to displace craniotomy from a considerable portion of its field. Hitherto the operation has been performed most frequently and most successfully in Germany, where the higher degrees of pelvic contraction are commoner than in England or America. The improvements introduced by Sänger consist essentially in the adaptation of Lembert's intestinal suture for the superficial sutures of the uterine peritoneum; and in the use of a large number of sutures, deep, and superficial, to secure perfect closure of the uterine wound, so that the lochial discharge is prevented from reaching the peritoneum.

Indications for the operation.—The indications for Cæsarian section have already been described in the chapters dealing with the various conditions which may call for it. They are chiefly comprised in the following: the higher degrees of pelvic contraction, and some cases of obstruction of the pelvis by tumours, cancer of the cervix, inflammatory deposits, or cicatrices which cannot be stretched. In Roman Catholic countries religious scruples about destroying the child to secure the safety of the mother have influenced the choice between craniotomy and Cæsarian section. In this country the interest of the mother will still be held paramount. But in cases in which, owing to the improvements in Cæsarian section, the risks of the two operations are nearly balanced, the interest of the child is justly allowed to have much weight. And now that the risk of Cæsarian section has become so moderate, it is reasonable, if that operation can be performed under favourable circumstances, in any case in which there is no hope of obtaining a living child even by induction of premature labour, to offer the mother the option of undergoing even a somewhat greater risk, to save the life of her child.

Time for operating.—The modern success in Cæsarian section has been gained chiefly in cases in which the operation has been decided on beforehand, and performed at the most favourable moment. If a patient has been long in labour, extraction through the pelvis is safer, except in the more extreme forms of distortion, as for instance when the conjugate diameter is $2\frac{1}{2}$ inches or less. It appears to be clear that the best plan is to allow labour to come on spontaneously, and to operate before rupture of the membranes, when partial dilatation of the os has been obtained. The only drawback is that this may often mean operating in the middle of the night. On this account some have operated before any commencement of labour: but then there is a difficulty in securing efficient drainage of the uterus. Another plan is to induce labour artificially, and operate as soon as a partial dilatation of the os has been secured. For this purpose a dilator may be introduced a few hours before the time fixed for the operation.

Instruments required.—The instruments desirable are scalpels, scissors, dissecting forceps, artery forceps, a dozen pairs of pressure forceps, large pressure forceps to hold elastic ligature, a flat director, curved needles and needle-holder, Hagedorn's or other; a dozen ovariotomy suture needles, that is to say, straight needles about three inches long; sponge forceps or sponge holders, for sponging out the deep corners of the peritoneal cavity; a set of soft and carefully cleaned sponges, twelve round and two large flat; sutures of silver wire or chromicised gut, of fine silk (Chinese twist), and of silkworm gut; strong new indiarubber tubing, about half an inch in diameter, for elastic ligature.

Assistants.—Three assistants at least are required—one to give the anæsthetic; one to stand opposite the operator, hold the uterus, and prevent protrusion of the intestines; one to receive the infant and resuscitate it, if partially asphyxiated; also a nurse to wash and hand sponges.

Antiseptic precautions.—The vagina should be irrigated previously with perchloride of mercury, 1 in 1000. The abdomen should be carefully washed with soap and water, the umbilicus cleaned out if necessary by liquor potassæ, the pubic hair shaved. The abdomen should then be washed over with perchloride of mercury, 1 in 1000. The utmost care should be taken to cleanse all instruments, and the hands of all who take part in the operation, including nurses, from any possibility of septic contamination. Hands and arms should be disinfected with perchloride of mercury, 1 in 1000. Sutures should have been immersed in carbolic acid, 1 in 20. Instruments, having first been boiled, should be immersed in trays of carbolic acid, 1 in 40.

Position of the patient.—The patient should be placed on a narrow table as for ovariotomy. Two dressing tables, placed together in a T shape, answer the purpose well, the head and shoulders of the patient resting on the table placed crosswise. The shoulders should be slightly raised, and the patient's feet directed toward the window, if daylight can be secured. It is well to pass a belt or bandage over the legs and secure it underneath the table, and also to fasten the wrists together by a bandage also passed underneath the table. In this way movement is checked, if it is found desirable not to keep the patient fully under the influence of the anæsthetic.

Anæsthetic.—Ether rather than chloroform should be chosen for the anæsthetic, since it does not relax the uterus so completely. If the uterus fails to contract well after removal of the fœtus, the anæsthesia should not be maintained too deeply. It must, however, be sufficient to prevent vomiting or straining, by which the intestines might be forced out.

The operation.—A mackintosh sheet, such as used for ovariotomy, having an aperture about eight inches long, the edges of which adhere to the skin of the abdomen, may be used with advantage, to prevent blood from running down underneath the patient. The bladder should first be emptied. Then an incision is made in the linea alba, as in ovariotomy. This should be about six inches long, and about a third of it should be above the level of the umbilicus, so that the incision ends two or three inches above the pubes. The incision should be made deliberately, and all bleeding vessels secured by pressure forceps. When the more superficial tissues are divided, the division between the recti muscles is sought for and the incision made through it. When the peritoneum is reached, after the sub-peritoneal fat is cut through, a small portion is pinched up with dissecting forceps and divided. A director is passed through the opening, and the peritoneum divided upon it to the extent of the external incision. The uterus will generally lie in contact with the surface through the whole extent of the incision. In some exceptional cases, however, there may be intestine lying in front at the upper part of the incision. If on percussion this has been ascertained to be the case, the assistant should, at this stage, place the palms of his hands at each side of the uterus, and press it as much as possible forward against the abdominal wall. In extending the incision downward close to the lower angle of the wound, it is a good plan, instead of using the director, to pass two fingers of the left hand as a director beneath the peritoneum, so as to elevate it somewhat, and thus to divide it between the fingers. If the bladder should be dangerously near, it will then be detected by the tips of the fingers, and there will be no risk of wounding it. This precaution is the more desirable if

Cæsarian section is performed after protracted labour, when the bladder will have ascended through the stretching of the lower segment of the uterus. Some ascent of the bladder must be expected in all cases in which labour is at all advanced (see Fig. 72, p. 155).

Before the uterus is opened, the elastic ligature, a piece of india-rubber tubing about a yard long, may be slipped over it, the centre of the tube being guided by the fingers over the top, and down the back of the uterus, care being taken that no intestine intervenes. The tube is not to be tightened, in general, until the fœtus has been removed. Some, however, prefer to apply the elastic ligature only after the fœtus has been extracted, and the uterus turned outside the abdomen. Other operators, again, now discard altogether the elastic ligature, as tending to paralyse the uterus, and trust to an assistant whose duty it is, as soon as the uterus is turned out of the abdomen, if any serious bleeding occurs, to compress the lower part of the uterus, with the broad ligaments, by one hand at each side. This is probably the best plan, if a sufficiently skilled assistant is available. Two or three sutures are now passed through the abdominal walls at the upper part of the wound, to be ready to close temporarily that portion of it, while the uterine sutures are being applied.

Up to this stage the operation is to be performed deliberately, and all hæmorrhage from the abdominal wound is to be stopped before the uterus is opened. During the next stage, the only check upon hæmorrhage is to proceed as rapidly as possible, and empty the uterus. The uterus should be steadied, and brought as nearly as possible into the middle line by the assistant who places his hands at each side of it. It should be remembered that the uterus is generally both inclined and rotated toward the right side. The incision through the uterine wall is commenced about the middle of the abdominal wound, and carried through to the internal surface. Then, when the membranes are reached, a director is passed in, and the uterine wall slit up upon it in each direction nearly to the extent of the abdominal incision. If the child is at full term, the length of the incision must be nearly 6 inches, to give space for the head to be extracted without difficulty.

The plan adopted by Dr. Murdoch Cameron of Glasgow, in order to limit the amount of hæmorrhage, is to flatten out a small Hodge's pessary, press it firmly upon the uterine wall, and make cautiously a small incision within its circuit until the membranes are exposed, then to slit up the uterine wall rapidly to the required extent, without rupturing the membranes.

Hæmorrhage is generally only moderate, provided that the placenta is not attached to the anterior wall, and therefore is not laid open by the incision. If the first incision enters the placenta, the main part of that organ may sometimes be avoided by extending the incision downwards only and not upwards, the abdominal incision being also extended a little further downward if necessary, with due regard not to injure the bladder. If the placenta cannot be avoided, the only resource is to cut through it as rapidly as possible, remove the child, and then at once detach the placenta. The position of the placenta cannot always be determined beforehand. If, however, the limbs of the child can be plainly felt over the front of the uterus, covered only by the thickness of the uterine wall, it may be inferred that the placenta is not situated there. If the limbs cannot be distinctly felt, and a greater thickness appears to intervene, it may be suspected that the placenta lies in front.

Removal of the fœtus.—As soon as the incision into the uterus is completed, the assistant should hook an index finger into each end of it, and, by this means, hold the uterus forward against the abdominal wall, so as to prevent liquor amnii and blood entering the peritoneal cavity, as far as possible. If the membranes are intact up to this point, the fœtus may be extracted by the head. The membranes are ruptured, and the hand rapidly passed down into the lower segment of the uterus, so as to scoop out the head. This plan has the advantage of avoiding the risk of the uterine wall contracting round the neck, and detaining the aftercoming head. If, however, the membranes have been ruptured some time, it may be necessary to extract the fœtus by the leg. In this case, the extraction of the head is facilitated, if some jaw traction is made with the index finger so as to flex the head. The funis is tied and divided, and the child handed over to the assistant who is prepared to attend to it.

As soon as the child is removed, the elastic ligature, if used at all, is drawn up tight, and secured by large pressure forceps. The next step is to turn the uterus out through the abdominal wound, in order to render it more accessible for the placing of sutures, and to stimulate it, if necessary, by pressure to contract. A large flat sponge is placed behind the uterus, and the upper part of the abdominal wound temporarily closed by placing catch forceps on the sutures already applied there.

The uterus is then stimulated to contract by kneading, and the placenta and membranes carefully peeled off. Special care must be taken that a piece of membrane is not left occluding the internal os.

Uterin esutures.—The muscular wall of the uterus is to be closed by from ten to fifteen deep sutures which approximate to, but do not include the mucous membrane, and about double that number of superficial sutures uniting the peritoneum in such a way as to fold it into the incision, and bring flat surfaces of it into contact (Fig. 253). In Sänger's original operation, in order to secure this end, the peritoneum was first undermined and separated from the muscularis by passing a scalpel under it about $\frac{3}{8}$ inch. Then a wedge-shaped strip of the muscularis was excised along each side of the wound, the broader end of the wedge being outermost, in order to allow the detached edge of the peritoneum to overlap into the wound. It has been found that both of these proceedings are unnecessary, and that the peritoneum is generally loose enough to draw over the edge without any separation.

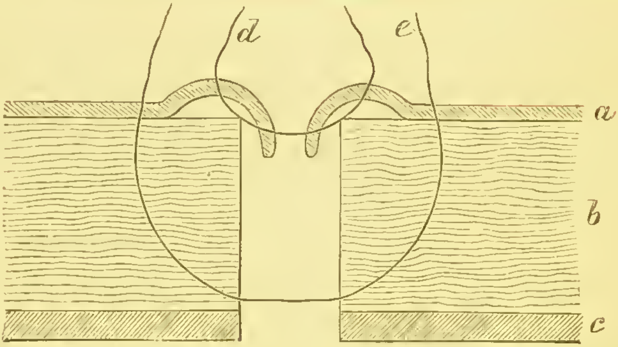

Fig. 253.—Diagram of mode of applying sutures in Sänger's operation. *a*, Peritoneum ; *b*, Muscularis ; *c*, Mucosa ; *d*, Superficial suture ; *e*, Deep suture.

Silver wire has usually been chosen for the deep sutures. Some, however, have used stout chromicised gut with success, and others silk. Carbolised gut cannot be trusted to hold long enough to prevent separation of the wound. Silver wire is the most reliable for not giving way, and for not causing suppuration. Chromicised gut has the advantage that the ligatures do not remain permanently in the tissues, and the same is true of silk, provided that it is aseptic. I have found boiled silk, No. 2 Chinese twist for the deep sutures and No. 1 for the superficial, answer excellently.

Curved needles, forming an arc of a circle, should be used for the deep sutures, so that they may be inserted not far from the edge and yet may include plenty of tissue (see Fig. 253). Hagedorn's needles and needle-holder (Figs. 259, 260, p. 718) are the best for the purpose. In inserting them the peritoneum should first be drawn over the edge of the wound by dissecting forceps, into the position which it is to occupy. The sutures are not to include the mucosa, so that they may not be exposed in the uterine cavity, nor conduct any septic material thence to the peritoneum. Dr. Murdoch Cameron threads silk with a straight needle at each end, and passes the needles from within outwards, as in the suture of the abdominal wall. The first suture bisects the incision, to make sure that the edges are not adapted unevenly. The superficial sutures should be of fine silk (No. 1 Chinese twist), and may be applied with a smaller curved needle. The suture is to pierce each side of the peritoneum twice, so that it turns inward flat surfaces of peritoneum into apposition with each other. In Figures 253, 254, are shown diagrammatically the sutures in section, before and after tightening.

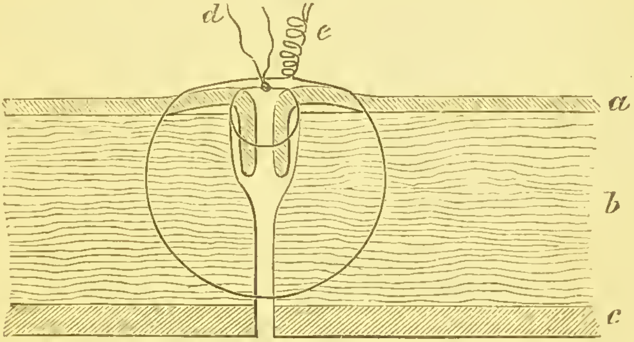

Fig. 251. – Diagram of sutures secured in Sänger's operation.
a, Peritoneum; *b*, Muscularis; *c*, Mucosa; *d*, Superficial suture; *e*, Deep suture.

It must be remembered that the deep and superficial sutures do not lie really in the same plane, but that, generally, two superficial sutures intervene between each pair of deep ones. All the sutures should first be placed, then the deep ones twisted, or tied, the ends cut rather short, if silver wire is used, and turned down into the line of incision, and finally the superficial sutures tied. If at any point the peritoneum does not come perfectly into apposition, more superficial sutures must be applied.

Before the sutures are tightened, the finger should be passed down through the cervix, to make sure that drainage into the vagina is clear. The interior of the uterus should be mopped over with perchloride of mercury, 1 in 1000, and some iodoform dusted into it. Before the uterus is returned into the abdomen, its peritoneal surface may be sponged over with perchloride of mercury, 1 in 2000. Although this plan of placing superficial sutures on the plan of Lembert's intestinal suture has seemed to be the most essential part of Sänger's operation, several operators have now discarded it for the sake of greater rapidity in the operation. They simply place numerous deep sutures, tie them up, and then add superficial or half-deep sutures to unite the peritoneum at any points where it does not seem to be thoroughly brought into contact. The result of this appears to be equally satisfactory. As many as three deep sutures to the inch should then be used.

The elastic ligature, if it has been used, is now taken off, contraction of the uterus secured if necessary by kneading, and the uterus returned into the abdomen. The next step is to sponge any blood or liquor amnii out of the peritoneal cavity, especially the pouch of Douglas, by passing down sponges, held in sponge forceps, or a metal sponge holder, into its dependent parts. The abdominal wound is then closed as in ovariotomy. The best material for the sutures is stout silk-worm gut. They may be applied either with straight ovariotomy needles or with curved needles. Care should be taken to pass the deep sutures through the recti muscles and fascia on each side as well as through the peritoneum. To secure a firm abdominal wall, and prevent risk of ventral hernia, a continuous buried suture should be used, of thin boiled silk or chromicised gut, to unite the fascia superficial to the recti muscles. Some superficial sutures may also be required, and these may be left a few days longer than the deep sutures.

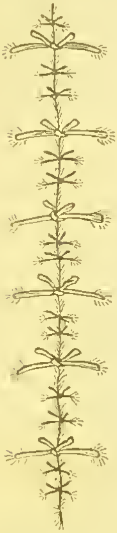
Fig. 255. — Sutures tied according to Sänger's method seen from above.

A dressing of cyanide or iodoform gauze may be placed over the wound, and secured by strapping. Over this is placed a large flat pad, and then a many-tailed bandage of flannel or swansdown calico, the tails being secured together by safety-pins. The dressing may generally be left untouched seven days. The abdominal sutures may generally be left ten days. But if a few are causing inflammation through tightness, these may be removed at seven days.

Some operators vary the mode of operating in certain respects. For instance some turn the uterus completely out of the abdomen before opening it, that no liquor amnii may escape into the peritoneal cavity. A much longer abdominal incision is then required.

In order to prevent future pregnancies, ligatures are sometimes placed on the Fallopian tubes. Kangaroo tendon, chromicised gut, and fishing gut have been used for this purpose. I have met with two cases in which pregnancy has occurred notwithstanding. The only safe method is therefore either to remove the ovaries or to tie each tube at two points and cut out a piece of it between the ligatures. Some have supposed that ligature of the tubes involves a risk of extra-uterine fœtation following, but such a result has not yet been reported.

In several cases, patients have undergone Sänger's operation a second time. The uterus has generally been found adherent to the abdominal wall; the silver sutures encapsuled in its substance.

After-treatment.—The after-treatment is similar to that after ovariotomy. The patient is kept on her back, a pillow being placed under the knees, and perfect quiet is maintained. The catheter is used as often as required. For at least twelve hours after the operation nothing should be given by the mouth, except a small quantity of water. If there is much vomiting at a later stage, nutrient enemata should be given. Otherwise liquid nourishment should be given by the mouth; at first chiefly milk, or milk mixed with barley-water. The addition of barley-water prevents the milk curdling in the stomach in such large lumps, and is useful if there is any tendency to vomiting. A morphia suppository should be given immediately after the operation, and may be repeated at intervals to relieve pain. If suppositories are not sufficient for this purpose, subcutaneous injections of morphia should be given. If the morphia appears to cause vomiting, $\frac{1}{100}$ grain of sulphate of atropia may be added to each injection. In many cases little or no sedative is required, and the patient is able to nurse her infant.

The vagina should be irrigated twice a day by means of a funnel and elastic tube, or irrigator only slightly elevated. Carbolic acid, 1 in 50, or chinosol, 1 in 2000, may be used for the purpose. If occasion arises for irrigating the uterus, owing to the lochial discharge becoming offensive, a non-poisonous antiseptic, such as chinosol, 1 in 2000, or creolin, 1 in 100, should be used. After each irrigation, a suppository, containing 10 grains of iodoform, should be introduced into the vagina, in order to prevent decomposition of the lochial discharge as far as possible.

Death sometimes occurs from hæmorrhage, but this rarely happens unless the patient is exhausted from protracted labour when the operation is undertaken. The usual cause of death is septic peritonitis, similar to that which occurs after ovariotomy if septic matter gains access at the operation. Such peritonitis must be treated in the usual way, but without much hope of success.

Post-mortem Cæsarian section.—When a pregnant patient dies, and the child is living and viable, it is right for the physician, with the permission of the friends, to perform Cæsarian section, in order to save the child. There are mythical stories of children having been saved in this way hours after the mother's death. In point of fact, however, the child does not remain capable of resuscitation for many minutes after her death. After more than fifteen minutes it is probably useless to perform the operation. If, therefore, it is to be of any avail, the practitioner must be present at the time of the death, and he should obtain the consent of the friends beforehand. He must also operate with whatever instruments he has on the spot. A penknife or razor has been used in the absence of more convenient implements. The incisions and mode of extraction are the same as in ordinary Cæsarian section. The child, if alive at all, will probably have to be restored by artificial respiration. If death takes place during labour, when the os is already fairly dilated, it will be preferable to extract the child rapidly by version or forceps.

Porro's Operation.

In Porro's operation, the main part of the uterus is removed, and the great danger of having a uterine wound, communicating with the peritoneal cavity, is thus avoided. Storer, of Boston, was the first who removed the uterus, without premeditation, in a case of Cæsarian section performed on account of a fibro-cystic tumour filling the pelvis. Finding the hæmorrhage alarming after incision of the uterus, he ligatured the cervix, and removed the uterus with an écraseur. The patient did not recover.

Porro, of Pavia, having devised his method, and tested it by successful experiments on animals, carried it out first in 1876 on
76 a patient having a rachitic pelvis with a conjugate diameter of $1\frac{1}{2}$ inch. This patient recovered; and since that time, a considerable number of operations has been performed, especially in Italy and Germany.

The operation.—The steps of the operation are the same as in ordinary Cæsarian section up to the incision in the uterus. It is of little consequence in what direction this incision is made, since it is to be removed with the uterus. If, therefore, it is suspected that the placenta is situated on the anterior wall, or if it is found to be so when the incision it commenced, it is a good plan to make only a short longitudinal incision rather low down on the uterine wall, and enlarge the space by a transverse incision crossing the first at its lower extremity. As soon as the fœtus is removed, hæmorrhage from the uterine wound should be temporarily checked by an elastic ligature. The placenta may then be left in the uterus, and the remaining steps of the operation carried out deliberately without hæmorrhage.

The rest of the operation is similar to that usually now adopted in hysterectomy for the removal of a uterus enlarged by fibroid

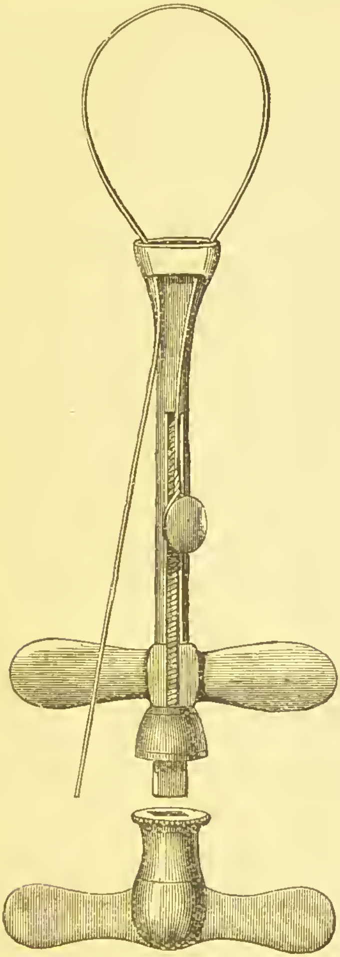

Fig. 256.—Kœberle's serre-nœud.

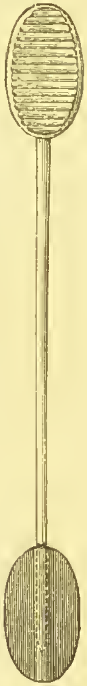

Fig. 257.—Guarded pin for fixing stump of uterus in abdominal wound.

tumour. The uterus is drawn out through the abdominal wound, the intestines being kept back by an assistant, and covered with a large flat sponge. A Kœberle's serre-nœud (Fig. 256), an instrument like a short écraseur, is fitted with a loop of thick soft iron wire, or what is better, with a wire of "delta metal," one end of the loop fixed to the moving button, the other end free. This loop is passed round the lower part of the uterus and adjacent portions of the broad ligaments, so that it passes below the ovaries, and below the lower end of the uterine incision. Care must be taken that no intestine or omentum is caught in the loop. The free end of the loop is now seized with a pair of pliers, drawn up pretty tightly and twisted round the button. The screw of the serre-nœud is then turned till the wire is tight enough to stop hæmorrhage, but not tight enough to cut the tissues. The uterus is then cut away about an inch above the loop. If there is any bleeding at this time from the stump, a little further tightening of the serre-nœud will stop it. It is important for success that the circulation beyond the loop should be completely cut off.

The stump of the uterus has next to be fixed as a pedicle in the lower angle of the abdominal wound. Two guarded pins (Fig. 257) are passed transversely through the pedicle just above the loop of wire, so that the ends lie on the abdominal walls, and keep the cut surface of the pedicle outside, the wire loop lying in a depression just below the pins. These pins, like the wires, are now made of delta metal, which does not rust or corrode. Large strong hare-lip pins might be used, in the absence of pins specially constructed. The abdominal sutures are then applied in the usual way above the pedicle, special care being taken in the adjustment of the lowest suture, so that it may bring the cut edges of the peritoneum into contact with the pedicle of the uterus all round, and with each other immediately above the stump. At this spot a buried suture of fine silk may be used, uniting the two edges of parietal peritoneum to the pedicle on the proximal side of the wire. It is well to place also one suture in the angle of the wound below the pedicle, so as to infold the edges of the peritoneum there also. The rest of the abdominal wound is closed as in the ordinary Cæsarian section. The toilette of the peritoneum is to be carried out in the usual way, and all blood and other fluid removed before the wound is closed.

In the absence of a serre-nœud, the operation may be carried out effectively by the permanent use of the elastic ligature. The ligature is tied tightly round the lower part of the uterus, passing below the ovaries, and the pins are passed through immediately above the ligature. Knitting-needles may be used for pins, and ordinary drainage tubing for elastic ligature; and thus the operation may be performed without any special appliances.

Dressing the wound.—The short stem of the serre-nœud is to be enclosed in the antiseptic dressings. The layers of gauze covering the abdomen may be slit up to some distance from below, so that the stem of the écraseur passes through the slit. Then a transverse layer of gauze is laid across below the stem, and the instrument itself is wrapped round with strips of gauze. The key of the serre-nœud (see Fig. 256, p. 707) is kept at hand, so that, in case there is any hæmorrhage from the stump, the nurse may be able to stop it at once by giving a turn to the screw. In other respects, the dressings are the same as for ordinary Cæsarian section.

After-treatment.—The wound should be looked at the day after operation; and the serre-nœud tightened, if there is any sign of vascularity in the stump. It becomes dry and leathery on the surface if circulation is properly arrested. The strangled portion of the pedicle may separate about the twelfth or fourteenth day, leaving a depression in the abdominal wall. Decomposition of the pedicle will have begun before this. As soon as it does so, the pedicle must be dressed daily or twice a day, and may be dusted each time with iodoform. Any redundant portions may be cut away from time to time. For the first few days a rather free use of morphia may be necessary, to relieve pain caused by the constriction and tension of the stump.

Choice between Sänger's and Porro's operations.—In both operations the results have in the hands of operators of experience been much better than the general average, and in both the results are progressively improving. According to the statistics collected by Dr. R. P. Harris, of Philadelphia, up to the end of 1889, there had been in fifteen countries 272 Porro operations, with 150 deaths; in thirteen countries there had been 212 Sänger operations, with 50 deaths. These figures, however, do not at all represent in either case the prospects of the operation when performed under favourable conditions. The minimum mortality of the Sänger operation, in skilled hands, is the less, and at Dresden and Leipzig, where it has been most practised, does not exceed 12 per cent. Recovery also is more rapid from this operation, and the patient suffers less febrile disturbance. But the results of Porro's operation have also greatly improved. The first 50 operations were fatal to 30 women, the last 50 up to 1890, to 10. In 1884 there were 29 operations, with 18 deaths; in 1888, 24 with 3 deaths. Of late years the general results, when cases in the hands of unpractised operators are included, have been not less favourable with Porro's than with Sänger's operation; but it is doubtful how far all operations described as Sänger's operations, really deserve the title.

The general conclusion is that, in the hands of a skilled operator, Sänger's operation is preferable, if decided on beforehand. When the patient has been long in labour, and especially if attempts have been made to extract through the pelvis, so that the uterus is likely to have been bruised, Porro's operation may give the better prospect. The complete failure of the uterus to contract, after the fœtus has been removed, would also be an indication in favour of Porro's operation.

Porro's operation is more rapid, and can be performed more readily without any appliances other than those which every practitioner has always at hand. If therefore a practitioner unpractised in abdominal surgery is suddenly called upon to perform one or the other, Porro's operation may be worthy of preference.

Porro's operation may be impossible to execute when Cæsarian section is performed on account of a fibroid tumour, lying in the pelvis, and occupying the lower portion of the uterus, including the cervix, or extending into the cellular tissue of the broad ligaments, for the lower segment of the uterus may then form too thick a mass to be surrounded by the wire, and fixed as a pedicle in the wound. In this case, and also in that of cancer of the cervix uteri, or pelvis, Sänger's operation is preferable.

Baer's operation.—In the case of pregnancy complicated by a fibroid tumour which involves the lower part of the uterus, and thus renders Porro's operation difficult or impossible, hysterectomy may be performed according to Baer's method, the essence of which consists in adopting the intra-pelvic treatment of the pedicle, but placing no ligatures nor sutures through uterine or myomatous tissue. The same operation may be chosen as an alternative to Porro's operation by a surgeon practised in abdominal operations.

The operation is performed in the following manner: After removal of the fœtus, the uterus is turned out of the abdomen, and hæmorrhage arrested by an elastic ligature below the level of the incision and the placental site. By means of a large curved, semi-blunt, pedicle needle, ligatures are placed on the broad ligaments, below the ovaries, securing the ovarian arteries, and the outer parts of the broad ligaments divided. Transverse incisions through the peritoneum are made half-an-inch above the bladder in front and at a corresponding level at the back, and the peritoneum is stripped down, including the bladder also in front. The uterine arteries can then be felt pulsating at the sides of the cervix, and ligatures are placed by means of the same pedicle needle so as to secure them. The uterus is then divided from the broad ligaments down to below the level of the internal os, and the cervix is cut across transversely so as to remove the uterus. But little bleeding takes place from the cut surface of the cervix. The peritoneum, before and behind, is then united by a continuous suture of fine silk or chromicised gut. The stump of the uterus is thus rendered extra-peritoneal, while the ligatures on the broad ligaments are left intra-peritoneal. As a rule, no drainage-tube is used, but one may be employed for twenty-four hours if there seems likely to be any sanguineous oozing. This method is commonly adopted for fibroid tumours apart from pregnancy.

LAPARO-ELYTROTOMY.

Another alternative to Cæsarian section is laparo-elytrotomy,* introduced by Thomas of New York in 1870. In this operation the opening of the peritoneal cavity and incision of the uterus are entirely avoided. An incision is made through the abdominal wall above the brim, the peritoneum lifted, the vagina opened, and the fœtus thus extracted above the pelvic brim.

History.—Ritgen had attempted the same operation in 1821, but the incision into the vagina caused so much hæmorrhage that the attempt was given up and Cæsarian section performed. The patient did not recover. Baudelocque the younger had also, in 1844, reported a case in which he succeeded in extracting a dead child by the same operation. He found it necessary to tie the common iliac artery to arrest hæmorrhage. In this case also the patient died. Thomas devised the operation quite independently. In 1870, in the case of a woman dying from pneumonia, he extracted a living child, which survived about an hour. Skene was the first who saved mother and child in an operation performed in 1875. Thomas had a similar success in 1877. The success, first of Porro's and then of Sänger's Cæsarian section, both of which are easier operations to perform, has displaced laparo-elytrotomy from favour.

The operation.—If possible, before the commencement of the operation sufficient dilation of the os should be secured to allow the child to be extracted through the cervix without much difficulty. This may be generally effected, if necessary, by the hydrostatic dilators.

The patient is placed flat at full length upon the table, the pelvis somewhat raised, and an anæsthetic is administered. The operator stands at the right side of the patient and operates on the right flank. The incision is similar to that for ligature of the external iliac artery. It should be parallel to Poupart's ligament and about five inches long, the outer end about an inch above the anterior-superior spine of the ilium, the inner end about an inch or an inch and a half above and to the outside of the spine of the pubes. As the incision is made, an assistant standing opposite to the operator draws the uterus upward and toward the opposite side, so as to put the skin upon the stretch. As the operation proceeds vessels may be tied with carbolised gut. The external epigastric artery must be divided, the internal epigastric artery is generally turned back with the peritoneum. Three layers of abdominal muscles have to be divided, layer by layer—the external oblique, the internal oblique, and the transversalis. The transversalis fascia is then pinched up with forceps, a small hole is made in it with the scalpel, and it is carefully divided upon a flat director, like that used in ovariotomy, revealing beneath it the fat in the vicinity of the peritoneum. A blunt instrument is then passed into the vagina, and held by an assistant in the direction of the wound in the groin. The operator then lifts the peritoneum by his fingers, so as to gain access to the vicinity of the instrument in the vagina. This is rendered easier by the loosening of the peritoneum in pregnancy. Next the instrument in the vagina is pushed up as much as possible, so as to make the vagina protrude in the wound. The operator now makes a small transverse incision into the vagina upon the guiding instrument. This may be done with scissors, or better, with Paquelin's benzoline cautery, or the actual cautery, heated only to a dull red heat, so as to cause the minimum of hæmorrhage. Next he enlarges the opening in the vagina by putting both index fingers into it, back to back, and tearing the tissues apart, forward and backward, in a direction parallel to the edge of the os. The object is to make the opening below and to the outside of the ureter, which might be injured in the operation. At this stage a sound should be held in the bladder by an assistant, so that laceration of the bladder may be avoided if possible.

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* Derived from λαπάρα, the flank; ἔλυτρον, the vagina.

When the opening is large enough to admit it, the hand is introduced, the membranes are ruptured if they are still intact, and the child extracted by version, or by forceps, if it appears that forceps can be easily applied. The difficulty of the operation consists in the dealing with copious hæmorrhage in the deep part of the wound, near the vaginal surface. So far as possible, the vessels should be secured through the abdominal wound. If this does not suffice to arrest hæmorrhage, a tampon may be applied consisting of long strips of iodoform gauze, and passed through the wound into the vagina, and a bandage should be applied firmly over the external wound. In any case the outer angles of the abdominal wound should be closed with sutures. If no tampon is required, only space enough should be left to allow a good-sized drainage-tube, with holes in the side, to be passed through from the outside into the vagina. Iodoform pessaries or tampons should be kept in the vagina, and the drainage-tube frequently syringed through with an antiseptic solution.

Prognosis.—The operation has not been performed often enough to allow any safe conclusion as to the prognosis to be formed, but hitherto the success has not been sufficient to enable it to hold its ground against the improved Cæsarian section. Out of twelve cases six of the mothers were saved. Some of them, however, were in desperate condition at the time of the operation. In several cases the bladder was injured, but the opening closed up spontaneously.

CHAPTER XXXVII.

ACCIDENTS DURING AND AFTER LABOUR.

RUPTURE AND LACERATION OF THE GENITAL CANAL.

LACERATION may take place at any part of the genital canal, but the most important varieties are ruptures of the uterus and adjacent portion of the vagina which involve the peritoneum, lacerations of the cervix, and lacerations of the perineum and vulva.

RUPTURE OF THE UTERUS OR VAGINA INVOLVING THE PERITONEUM.—Rupture of the uterus reaching the peritoneum is one of the most dangerous accidents of labour. Rupture of the vagina into the pouch of Douglas is closely allied to it, and is frequently combined with rupture of the uterus itself.

Frequency.—The frequency of rupture of the uterus has been variously estimated at from 1 in 1,300 to 1 in 3,403 deliveries (Jolly). In the Guy's Hospital Charity, when assistance to labour was given very sparingly, forceps cases being only about 1 in 200 deliveries, there were seven cases of rupture of the uterus or vagina in 23,591 deliveries, or 1 in 3,371, a result closely agreeing with that obtained by Jolly from the statistics of 782,741 labours in Paris. In the following ten years, forceps cases being 1 in 93, cases of rupture of the uterus or vagina were only 1 in 5,098.

Causation.—The rupture is caused by a violent contraction of the uterus, which is unable to cause advance of the fœtus, and proves too strong for the resistance of the thinned portions of the uterus or the vagina. Among predisposing causes are weakness from malnutrition, or fatty degeneration, of the part where rupture takes place. Inefficient action of the auxiliary muscles also promotes rupture, because the auxiliary forces, tending to depress the whole uterus at each pain, take some of the strain off its attachments to the pelvis. Laxity of the abdominal walls, or their being overloaded with fat, is therefore also a predisposing cause. Another important cause is obliquity of the uterus. Any deviation of the uterus from the axis of the genital canal at the level where the head, or other presenting part, is lying, diminishes the efficacy of the force in causing advance of the fœtus. It is therefore liable to evoke a more vigorous contraction of the uterus than would otherwise be necessary to complete labour. At the same time the deviation causes a certain proportion of the force to be uselessly expended in pressure on the opposite wall of the genital canal, and therefore increases the liability to rupture at that part. Thus, if there is a deviation of 30°, there is a useless pressure on the opposite wall of the genital canal equal to one-half of the expulsive force.

In the great majority of cases rupture is preceded by an excessive stretching and thinning of the lower distensible segment of the uterus. In very exceptional cases this may occur even in the first stage of labour. Much more frequently, it happens during a second stage, prolonged in consequence of obstruction to the advance of the fœtus. As previously explained (see pp. 439—441), the strong contractile portion of the uterus gradually retracts over the fœtus, the internal os uteri becomes more and more elevated, and the distensible part of the uterus becomes stretched longitudinally as well as laterally, and thus greatly thinned. This distensible portion consists of the cervix, and of that lower segment of the body of the uterus immediately above the internal os which has to be expanded to allow the passage of the fœtus. The most frequent causes which lead to the over-stretching are disproportion between the fœtus and the pelvis, hydrocephalus, and unrectified shoulder or transverse presentations. The tissue which gives way may have been weakened by the effects of prolonged pressure against the promontory of the sacrum or other part of the pelvic wall. The risk of rupture is of course increased if the action of the uterus is excessively violent, either in consequence of great susceptibility of the patient to reflex stimulus, or to the injudicious administration of ergot or other oxytocic remedy.

In comparatively rare cases rupture takes place suddenly and unexpectedly without any protraction of labour, or disproportion between the fœtus and the pelvis. It must be explained in these cases by a sudden and excessively violent contraction of the uterus, probably associated with some deviation of its axis, and some unusual weakness in the tissues which give way. I have met with two instances in which rupture occurred not long after the escape of the liquor amnii and before the head had descended into the pelvis, in women who had previously borne many children without difficulty. In one the accident happened when the woman was straining upon a night-stool, and there was reason to believe that, in both, the uterus was anteverted at the time. The rupture in each case was not through any over-distended cervix, but across the vagina, at its junction with the cervix. It is clear that, in anteversion of the uterus, when the head is lying above the brim, especially when there is also a projecting sacral promontory, the uterine force may drive the head, not downwards into the pelvis, but against the promontory. When rupture takes place, the head may be deflected upwards by the promontory, and the whole fœtus may escape into the peritoneal cavity, with the head uppermost.

Rupture may also be brought about by efforts to deliver artificially, especially by the attempt to turn in shoulder presentations long after the escape of the liquor amnii, or by the performance of any obstetric operation without an adequate amount of dilatation of the cervix. The rupture, in such cases, may be a longitudinal rent extending from the edge of the cervix into the uterus, or may take place, like a spontaneous rupture, in the stretched segment of the uterus.

Ruptures of the uterus are more common in multiparæ than in primiparæ, and in women over thirty years of age than in younger women. The reason is that, in multiparæ, and in older women, laxity of the abdominal walls, deviation of the uterus, and degeneration of tissue are more likely to exist. According to Bandl, only 11 per cent. of all cases of rupture occur in primiparæ.

Pathological anatomy.—Rupture almost always commences in the distended part of the uterine wall, but it may extend upwards to some extent from this into the body of the uterus. In some exceptional cases rupture may commence in the body of the uterus, as when there is a weakened portion of the wall in association with a fibroid tumour, or when the cicatrix of a former Cæsarian section gives way. The initial rupture is necessarily transverse to the line of greatest tension. Thus, in cases of hydrocephalus or shoulder presentation, when too bulky a mass is forced down into the cervix, the line of rupture is frequently longitudinal. Otherwise it is more generally transverse, or partly transverse and partly longitudinal. Rupture may take place at any part of the circumference, but is rather more frequent posteriorly. If anterior, it may separate the uterus from the bladder. Generally it extends more or less to one side, involving the broad ligament. The rupture may involve the vagina and the cervix together. When the vagina alone is implicated, the line of rupture is generally transverse, near the line of union with the cervix.

When rupture has taken place, the uterus may retract off the fœtus, expelling the fœtus either partially or wholly through the rupture into the peritoneal cavity, and sometimes the placenta also. This is more likely to take place if the rupture occurs when the head is still above the brim.

Symptoms and Course.—If an extensive rupture takes place suddenly, the patient generally feels a sudden acute pain and sensation of tearing. The pains, which generally have been violent up to that time, cease suddenly and completely. Gradually increasing continuous abdominal pain is substituted for the rhythmical pains of labour. The pulse becomes rapid, and the anxious face, prostration, and often vomiting and pallor, indicate shock and internal hæmorrhage. There is sanguineous discharge from the vagina, and the presenting part recedes. In the majority of cases, when the fœtus is still above the brim, it passes away out of reach through the rent into the peritoneal cavity.

When the rupture is more gradual, being extended by successive pains, there may not be any sign making it obvious exactly when the accident has occurred, and the pains cease more gradually. In all cases, however, when the rupture is complete, the pains cease, there is hæmorrhage from the vagina, and a rapid pulse. If the presenting part is low in the pelvis, it may remain without obvious recession, but merely cessation of advance. In rare cases rupture has been found after spontaneous expulsion of the fœtus, having taken place in the final pain.

Diagnosis.—A probable diagnosis from the symptoms above described is generally easy. It is to be completed by passing in the hand and feeling the rent, and the empty uterus, if the fœtus has escaped into the abdomen. The outline of the fœtus may also be felt through the abdominal wall and the uterus as a separate mass. If the presenting part still occupies the vagina, the diagnosis can only be made from the symptoms, until delivery has been completed.

Prognosis.—The prognosis is extremely unfavourable. There is so much shock, and generally such copious internal hæmorrhage from the rent, that the patient often sinks before there is any opportunity for giving surgical aid. Moreover, the repair of the rent is itself often very difficult. Again, unless abdominal section is performed, there is blood remaining in the peritoneal cavity. The mortality has been variously estimated at from 84 to 95 per cent. The cases of recovery have chiefly been in patients in the country. But the application of the principles of the improved Cæsarian section offers hope of improved results in cases where the primary shock and hæmorrhage are not too great to allow of abdominal section. This hope has already been justified to some extent. The child is inevitably lost in all cases in which it escapes through the rupture.

Death sometimes takes place within a few hours from hæmorrhage and shock. More frequently it occurs after three or four days from septic peritonitis. The danger is greater when the rent has been enlarged by the passage of the fœtus through it into the abdomen.

Prophylaxis.—The most important part of prophylaxis consists in affording timely aid by forceps or other means in all cases of obstructed labour, especially when any contraction of the pelvis is discovered, and in avoiding the administration of ergot in all such cases. The necessity for timely interference is especially to be borne in mind when the pains appear to be excessively strong, without producing any advance of the fœtus. The patient should not, however, be checked from bearing down in such cases, since the action of the auxiliary muscles tends to diminish both the thinning of the lower uterine segment and the risk of rupture, as already explained (see pp. 170, 713). In shoulder presentations and in hydrocephalus early diagnosis and treatment are of importance. A useful indication of danger is the recognition through the abdominal wall in protracted labour of the transverse line of depressions at some height above the pubes (see page 490). This is probably formed by the internal os, and proves that the lower segment of the uterus is dangerously thinned. If it is detected in protracted labour, it is time to give assistance of some sort, but, in head presentations, version should be avoided, or only attempted with great caution.

Treatment.—If the child remains within the uterus, the diagnosis of rupture can generally be made only from the symptoms. Rupture being suspected, the child should be extracted as rapidly as possible. If extraction with forceps meets with any difficulty, craniotomy should be performed without hesitation, since the child is rarely saved after rupture has taken place. The safest instrument for extraction afterwards is craniotomy forceps, since the position of the outer blade can be exactly adjusted by the fingers, while the cephalotribe might possibly be passed through the rupture, and injure the maternal structures. It is well to keep the patient in the dorsal position throughout the operation, as well as afterwards. Air is then not so likely to be sucked into the peritoneal cavity in respiration, and less blood will gravitate into it.

After extraction of the child, the placenta should be removed quickly, the hand being introduced for the purpose if necessary, lest it should escape into the peritoneal cavity. If it has already done so, it may be drawn back through the rent, if this can be effected easily without risk of injuring the intestines. Otherwise the presence of the placenta in the peritoneal cavity may determine the balance of advantage in favour of performing abdominal section, and removing it by that means.

If the whole child has passed through the opening into the peritoneal cavity, or even if the head has passed through, no attempt should be made to draw it back again through the opening. If this is attempted, the laceration and bruising are likely to be increased. Moreover the uterus, being more or less emptied, will have retracted. The pelvic space will therefore be partly occupied by the double thickness of its thickened wall, instead of merely that of the attenuated wall expanded over the fœtus. By this circumstance the difficulty of extraction may be greatly increased, if there is any disproportion between fœtus and pelvis, and therefore also the risk of injury.

The right treatment is to perform abdominal section, remove the fœtus, clear out clots and blood from the peritoneal cavity, and, if the site of the rupture is accessible, unite the edges of the peritoneum by sutures. The incision through the abdominal wall is to be made in the linea alba, as in ovariotomy or Cæsarian section. This treatment has given promising results, so far as it has yet been adopted.

If possible, the sutures should be applied on the same principle as in Sänger's Cæsarian section, deep sutures through the muscular wall of the uterus, avoiding the mucosa, or through the cellular tissue if the rent involves the broad ligament or vagina, and superficial sutures about twice as numerous uniting the peritoneum, and turning in its edge either on one side or on both. The former may be of silk, stout chromicised gut, or silver wire, the latter of fine silk. If the rent is posterior, as it usually is, the uterus should be turned out through the abdominal wound, and the intestines held back by large flat sponges, so as to allow access to it, if possible. If it is anterior, it is comparatively easy to apply the sutures. The deep sutures arrest the bleeding, if they can be successfully applied. In cases in which it proves impossible to unite with deep sutures the torn surfaces, Leopold has adopted with success the following plan. A long strip of iodoform gauze is placed within the peritoneal cavity, so as to approximate the surfaces, and arrest bleeding by pressure, and the end is brought out at the lower part of the abdominal wound. After twelve hours or more, the strip is removed by means of this end. In some cases, it may be preferable to bring the end of the gauze out through the vagina, and remove it through that passage.

In some cases the uterus has been removed, as in Porro's operation. But it is only in the rare cases in which the rent involves the fundus that the whole rent can be removed by this means. And even then the shock of this operation, added to that already existing, is a serious disadvantage.

The peritoneum should be cleansed by washing it out with hot water at 105° F. rather than by sponging merely.

Even if the fœtus remains within the uterus and is removed through the vagina it is sometimes advisable to perform abdominal section for the purpose of cleansing the peritoneum from blood and clots. For generally a large quantity of blood escapes into the peritoneal cavity, and is the chief cause of the septic peritonitis, germs of decomposition gaining access through the rent. This treatment is most likely to be successful if the rupture is so situated that it is likely that the rent can be closed by deep sutures from the peritoneal side. A condition of great collapse, from hæmorrhage and shock, would be a contra-indication to the operation. If the rupture is very low down on the posterior uterine wall or vagina, it would probably be impossible to reach it, in order to close it by sutures, from the abdominal surface. In such case, the introduction of a drainage tube, or of a roll of iodoform gauze, to serve as a drain, may be preferable to the performance of abdominal section. The peritoneal cavity may first be washed out with hot water by a tube passed from the vagina through the rent, the patient being in the dorsal position. The drainage tube should be rather stiff and fully as large as the little finger. A T-shaped tube may be used, having holes in the upper transverse portion, which is passed through the rent, and serves to retain the tube. In the absence of such a tube the plan recommended by Felsenreich* may be used. A piece of thick, stiff drainage tube is bent upon itself at the centre, and a large hole cut on the outside of the bend. The descending arms of the tube are fastened together, and the bend passed through the rupture. The tube is kept in place by stitching the lower part of it to the edge of the perineum. For this purpose a fishing gut suture will be the best to use.

In some cases, where the rent involves chiefly the vagina and broad ligaments, it may be possible to pass from the vagina deep sutures to arrest hæmorrhage by uniting the main part of the torn surfaces, leaving a space for drainage from Douglas's pouch.

Leopold advises that the cavity of the uterus and vagina should be packed with iodoform gauze to aid in making pressure upon the rent, whether abdominal section is performed or not. The plug is to be left several days. In some cases, he passes the strip of gauze from the vagina through the rent, and out at the lower part of the abdominal wound.

After-treatment.—The patient should be kept constantly on her back, as after ovariotomy or Cæsarian section, and the bladder emptied by catheter. Unless the vaginal plug is used, suppositories containing iodoform, or tampons dusted over with iodoform, should be kept constantly in the vagina. The vagina should be frequently irrigated with an unirritating antiseptic solution, such as a solution of boric acid. Special care must be taken that the outflow is free, and the irrigator should only be raised very slightly above the level of the vagina. After the first two days, when peritoneal adhesions are likely to have formed in the neighbourhood of the rent, stronger antiseptics, such as a solution of chinosol or creolin, may be used, if there is any tendency to decomposition of the lochia. In other respects, the after-treatment is similar to that after Cæsarian section.

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* "Beitrag zur Therapie der Uterusruptur." Archiv. für Gynæk., Band XVII., Heft 3.

INCOMPLETE RUPTURE OF THE UTERUS. — There are two varieties of incomplete rupture of the uterus. In the first, the muscular wall is torn, while the peritoneum remains intact; in the second, the peritoneum is torn, while the main portion of the muscular wall does not yield. Incomplete rupture of the muscular wall takes place chiefly at the sides of the uterus, where the peritoneum is not in such close contact with the muscle. It is hardly possible for it to occur at the front or back of the uterus, except at the lower part of the anterior wall, between uterus and bladder. It is much less common than complete rupture. The peritoneum becomes detached over a considerable surface, and blood is poured out beneath it, forming a hæmatoma, especially when the site of the rupture is between uterus and bladder. In some cases of complete rupture a similar detachment of peritoneum and effusion of blood are formed, showing that an incomplete rupture had preceded the complete. A less severe degree of internal rupture, not dividing the whole thickness of the muscular wall, may be produced at the internal os by efforts to deliver rapidly, before the internal os has fully expanded.

Symptoms.—The symptoms of incomplete rupture are much less marked than those of complete, and the diagnosis is more difficult. The pains generally continue, although they may become less efficient. The chief symptoms are acceleration of pulse and hæmorrhage. Little or no blood, however, may escape externally, if the presenting part prevents its exit. A sign which has been observed in some cases is that of emphysema of the anterior wall of the uterus, or extending to the iliac fossa, and even to more distant parts. The air may find entry from the vagina, or there may be gas arising from decomposition of the fœtus. Cases in which emphysema has been noted have generally ended fatally.

Prognosis.—Although the accident appears much less severe than that in which the peritoneal cavity has been opened, the mortality of recorded cases has been high. Death has often occurred from septic peritonitis, or cellulitis spreading from the vicinity of the blood-clot.

Treatment.—If the accident is suspected, delivery should be effected rapidly as in the case of complete rupture. Hæmorrhage can generally be arrested by securing contraction of the uterus, after removal of the placenta. The after-treatment consists chiefly in preserving the discharges from decomposition, by frequent syringing with antiseptic solutions and the use of iodoform pessaries.

RUPTURE OF THE PERITONEAL COVERING OF THE UTERUS.—The second variety of incomplete rupture has been described in a few cases in which death has occurred from hæmorrhage or shock, or from subsequent peritonitis. Cases not ending fatally would probably escape recognition.

PERFORATION OF THE UTERUS.—Localised inflammation and sloughing of the uterine wall may be produced by prolonged pressure between some projecting part of the pelvis and the presenting part of the fœtus, especially when the head is presenting. The bony prominence most likely to cause this effect is the promontory of the sacrum in a flattened pelvis. In protracted labour, especially when the head is arrested above the brim, the internal os may be so much elevated by retraction of the uterus, that the sacral promontory corresponds to a portion of the cervix, or, at any rate, of the thinned lower segment of the uterus. In the more rare case in which there are projecting spines or bony prominences at other parts of the pelvis, as at the symphysis pubis, these also may cause a similar local lesion in the uterus. Sloughing, especially at the site of the sacral promontory, is most commonly due to prolonged pressure, when labour has been left too long unassisted. It may also result from injury in very difficult instrumental delivery, or from the use of unsuitable instruments, or the unskilful use of instruments.

The portion of the uterine wall which sloughs may give way and form a rounded or funnel-shaped perforation into the peritoneal cavity; or its inner or outer portion may alone give way, not producing a complete perforation. In sloughs on the anterior wall, the peritoneal cavity is not usually reached, but only the cellular tissue in front of the uterus. As in the case of sloughs causing vesico-vaginal fistula, the perforation generally does not take place before, or at the time of, delivery, but after an interval of some days. It is not so fatal as rupture of the uterus, because peritoneal adhesions may have meantime formed around it. It may, however, set up general peritonitis, and is one of the causes of death after difficult labour.

LACERATIONS OF THE VAGINAL PORTION OF THE CERVIX.—Slight superficial lacerations of the mucous membrane at the edge of the os are almost inevitable in labour. Deeper lacerations are of common occurrence. These may extend either partially or wholly up to the vaginal reflection, or may even reach the adjoining portion of the vagina and subjacent cellular tissue. It is very rare for lacerations commencing at the edge of the cervix to extend up to the internal os, but rents caused by forcible delivery with an undilated cervix may possibly do so. They then virtually become incomplete or complete ruptures of the uterus, as the case may be.

Transverse lacerations, parallel to the edge of the os, are much more rare. Such a laceration may be produced by pressure of the advancing head, when there is deviation of the os uteri to one side; or the anterior lip, compressed between the occiput and the pubes, may become injured and inflamed, and may give way in the form of a transverse laceration. Cases have even been recorded in which, when the os is very rigid, such a laceration has extended all the way round, and separated the edge of the cervix in the form of a ring. This constitutes an annular laceration.

Causation.—Laceration results from rigidity of the cervix, combined either with activity of the expelling forces, or artificial extraction. The rigidity may either be due to a previous inflammation or hyperplasia of the cervix, or to labour occurring for the first time late in life. Premature rupture of the membranes greatly predisposes to laceration, through the failure of the natural mechanism for gradual dilatation. The lacerating force may be the natural expulsive power, or that expended in delivery by forceps, or traction in pelvic presentations or after version.

Symptoms and results.—There is generally no symptom which attracts notice at the time of the laceration, the pain produced being merged in the pain of uterine contraction. Until delivery hæmorrhage is generally checked by the presence of the fœtus. After delivery, hæmorrhage may occur, and form one of the varieties of post-partum hæmorrhage. It is only in exceptional cases, however, that it is sufficient to call for any special treatment.

The slighter lacerations generally heal more or less completely during the puerperal period, but often leave the cervix irregular, and marked by notches radiating from the cervix. A deep laceration reaching the vaginal reflection is apt to cause local cellulitis in its neighbourhood, owing to absorption at the raw surface. This is proved by the frequency with which, when an old ununited laceration is discovered long after the labour which gave rise to it, a band of thickening in the cellular tissue running from the angle of the laceration can also be detected. Septic absorption of a more grave character at the same site may give rise to puerperal septicæmia. When laceration is deep, and especially when the cervix is lacerated at both sides, the clefts are apt to remain unhealed, and the anterior and posterior lips of the cervix to become everted and hypertrophied. The lining membrane of the cervix, naturally clothed with cylindrical epithelium, is thus exposed to friction, and to the action of the vaginal secretion. The result commonly is a granular inflammation of the exposed surface, a condition which was formerly regarded as ulceration or erosion of the cervix, before attention was called by Emmet of New York to the frequency and to the results of cervical lacerations. The effect of unhealed laceration of the cervix may thus be chronic uterine trouble, lasting for many years.

Diagnosis.—The laceration may sometimes be noticed at the time of its occurrence, or suspected from the sudden yielding of a long resisting cervix. In all cases, when the placenta is removed, and the finger introduced to feel whether any clots remain in the vagina, the physician should examine the cervix, which hangs limp and flaccid, to determine whether there are any rents in it, and their degree.

Prophylaxis.—The most important point in prophylaxis is to avoid increasing the number of lacerations which would occur spontaneously by using forceps unnecessarily before full retraction of the os, or by extracting too hastily in those cases in which forceps are called for. When laceration is threatened by rigidity of the os in association with violent pains, all means should be used to promote relaxation, such as hot water irrigation, and, above all, the administration of chloroform. After premature rupture of the membranes, if the os does not readily yield, laceration may sometimes be averted by the judicious use of dilating bags or dilatation with the fingers (see pp. 454—457).

Treatment.—Hæmorrhage may be checked by hot or cold water syringing, or application of a piece of ice, or, if necessary, by pressure with a sponge or swab of cotton soaked in a styptic, such as a saturated solution of alum or a solution of perchloride of iron. A still better and more scientific plan is to arrest the hæmorrhage by uniting the laceration by sutures. For this purpose, the patient should be placed in Sims' semiprone position, lying on the side opposite to the laceration. Sims' speculum should be used, or the cervix drawn down to the vulva by tenaculum forceps. The best material for sutures is stout fishing-gut or silver wire. Two sutures are generally sufficient for one side of the cervix, and these may be applied with a straight needle held in a needle-holder, or, still better, by Hagedorn's needle-holder (Fig. 260, p. 729) and curved needles. They should be removed at the end of a week. The sutures should be passed through the whole thickness of the cervix, just including the edge of the lining cervical mucous membrane. Either an anæsthetic should be dispensed with for the operation, or so much time should be allowed first to elapse after delivery that there is no longer fear of hæmorrhage from uterine inertia. It is not usual to perform an immediate operation on the laceration, in those cases in which there is no bleeding of consequence. For it appears that, in general, if careful vaginal irrigation is employed, and all sepsis avoided, fair healing of the lacerations takes place spontaneously.

If a laceration has been detected after labour, it is desirable to examine the condition of the cervix some weeks after delivery, in order to decide whether the operation of trachelorraphy is called for, or whether any other treatment is necessary.

Lacerations of the Vagina.—Lacerations of the posterior vaginal cul-de-sac reaching the peritoneum, and vaginal associated with cervical lacerations, have already been described. In the middle portion of a normal vagina, spontaneous laceration rarely occurs, since the canal is capable of stretching to the dimensions of the pelvis. If, however, the vagina is contracted by old cicatrices, laceration may take place, and may reach even the bladder or the rectum. Vaginal lacerations may also be produced by unskilful use of instruments, or by projecting angles of bone in craniotomy.

Treatment.—Sutures will rarely be required, unless the bladder or rectum is laid open. Hæmorrhage may be arrested by cold or pressure with styptic applications. Care should be taken afterwards to guard against decomposition of lochia in the vagina.

Lacerations of the Vaginal Outlet, Vulva, and Perineum.—The vaginal outlet, formed by the insertion of the hymen, is the narrowest point of the canal, and suffers inevitable rupture in primiparæ.* In coitus only the edge of the hymen becomes notched, the notches not reaching quite to its base. In parturition lacerations extend quite to its base, and reach the cellular tissue of the vaginal wall. These lacerations are longitudinal, being perpendicular to the direction of greatest tension. The main tear is generally posterior, but there are usually others also. Hence, the condition of the hymen generally affords positive evidence as to previous parturition.

Laceration of the perineum in primiparæ generally commences by extension into the substance of the perineal body from the inevitable tear at the vaginal outlet, which is shown by the line *e c* in Fig. 260, p. 726. The term perineal body is applied to the lower part of the recto-vaginal septum. A longitudinal section of this forms (roughly) a triangle (*a b c*, Fig. 260), the base of which (*b c*) is constituted by the perineum proper. Up to the first parturition, the remnant of the hymen at the vaginal outlet (*d*, Fig. 260) forms a projection forward near the lower extremity of the anterior or vaginal face of the triangle. A considerable laceration of the vaginal face of the triangle, occurring by extension upwards and inwards of the inevitable tear, *e e*, may take place without the perineum itself, or even the fourchette, or fold of skin uniting its anterior border, being involved at all. This may divide so much of the anterior fibres of the levator ani (see Fig. 78, p. 170), that the action of that muscle in coitus, and the value of the perineal body as a support for the vagina, are impaired thenceforward, the perineum being left only as a thin septum, like an artificial perineum produced by a badly-performed operation. In rare cases, a superficial cutaneous crack of the perineum is alone produced, the skin being less distensible than the muscle beneath, which remains intact.

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* By Budin the hymen itself is regarded as forming the termination of the vagina and the free margin of the hymen therefore as being the vaginal outlet; but this view has not been generally accepted.

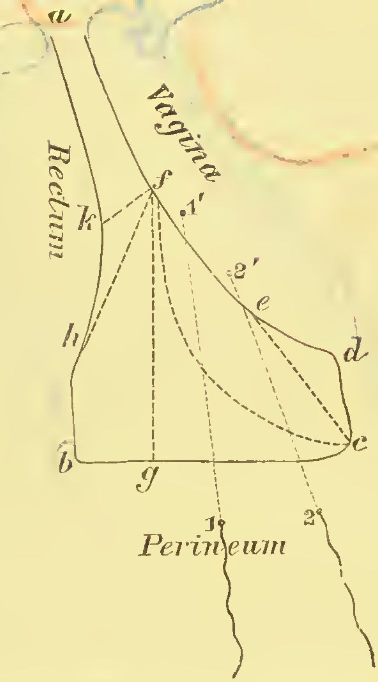

Fig. 258.—Antero-posterior section of perineal body in primiparæ. *a*, recto-vaginal septum; *b c*, perineum; *c*, fourchette; *d*, vaginal outlet, formed by remnant of hymen; *c d*, fossa navicularis; *e c*, inevitable laceration in primiparæ; *f c*, deeper laceration of vaginal surface of perineal body not involving perineum itself; *f g*, laceration of perineum up to sphincter ani; *f h*, *f k*, lacerations dividing sphincter ani; 1 1′, 2 2′, show position of sutures for uniting the laceration. The section shows the shape of the perineal body when slightly stretched transversely, as by the advancing head. In its unstretched condition the fourchette (*c*) lies posterior to the vaginal outlet (*d*).

Deep lacerations.—More frequently, as the laceration spreads, it involves the perineum proper and extends more or less from the fourchette backward toward the anus. Sometimes only just the anterior margin is torn through, and women who have had several children rarely escape so much laceration as this. In a more severe form of rupture the laceration extends backward as far as the sphincter ani, as shown by the line *f h* in Fig. 258. Sometimes the tear forks on reaching the sphincter, going a little to each side without dividing the muscle. In others the skin only may be divided as far as the anus, while the muscle beneath remains intact. In the severest form of all, the sphincter ani is divided, and more or less of the recto-vaginal septum, as shown by the lines *f g*, *f k*, in Fig. 258. The line of rent in the recto-vaginal septum generally deviates somewhat to one side, avoiding the central posterior column of the vagina, where the tissue is thicker and stronger. In parous women, in whom the inevitable laceration at the vaginal outlet must have taken place at a former delivery, rupture generally commences at the anterior margin of the perineum, and extends backward from that point.

Central rupture.—In rare cases, when the vulval outlet is very narrow and far forward, and when the head is driven backward, what is called central rupture of the perineum occurs, laceration taking place from the vagina through to the perineum, leaving the anterior portion of the perineum intact in front. Cases have been recorded in which the rent has extended backward through the sphincter into the rectum, and the child has been born through the opening, a bridge of perineum in front still remaining unruptured.

Causation and Prophylaxis.—The stage of delivery at which laceration is liable to occur, and the precautions to be taken for avoiding it, have been described in the chapter on the management of normal labour (see pp. 214—216). It may be added here that laceration may sometimes be produced before the fœtus reaches the pelvic floor, when the hand and arm, or instruments, have to be introduced, especially in difficult cases of craniotomy. For the precautions to be used to avoid lacerating the perineum in forceps delivery, see pp. 634—636.

Diagnosis.—If a careful watch is kept upon the perineum whenever rupture is threatened, any laceration will be noted at the time of its occurrence. Visual examination is better than digital, and can be made at the time when the placenta and membranes are removed from the vagina. Care should be taken to have a sufficient light, if there is any doubt about the perineum being perfectly intact. Some practitioners have been known to say that they never see rupture of the perineum in their practice. This statement proves only that they are not accustomed to examine their patients after delivery with sufficient care.

Symptoms and Results.—There are generally no notable symptoms at the time of laceration, the pain being merged in the distress of the final pains of labour. Hæmorrhage is usually not considerable, unless the rupture extends far up the recto-vaginal septum. After delivery, there is soreness at the site of laceration. If the laceration is not united by sutures, a certain amount of spontaneous union may take place. Generally, however, if the laceration is deep, there is but little union of the separated surfaces, and such apparent diminution of the size of the rent as takes place is due to some contraction of the healing surface, and filling up of the angle by granulation. During the puerperal period, the raw surface affords a site for the absorption of any septic material which may be present, and may thus form the starting-point for puerperal septicæmia. If septic infection has taken place, this surface may become sloughy, or may be covered by a greyish exudation. If a considerable laceration has occurred and is not united, the following are the subsequent results. The support given by the perineal body to the anterior vaginal wall is taken away. Hence there is liability to prolapse of the anterior vaginal wall, which may in turn draw down the uterus. The gaping vaginal outlet may also allow prolapse of the posterior vaginal wall, independently of the uterus. The sexual power of the woman is also impaired in consequence of the division of the sphincter vaginæ and anterior fibres of levator ani.

Treatment.—In all cases in which rupture has occurred beyond the extent of a mere notch in the mucous membrane or at the fourchette, it should be closed immediately by sutures. The object of this treatment is not only to avert the subsequent evils arising from an ununited laceration, but to diminish the absorbent surface capable of proving the starting-point of septicæmia. If there is merely a slight rent affecting the vaginal mucous membrane only, and not reaching the perineum proper, sutures are not generally required.

If, however, there is a deep rent in this situation, as shown by the line *f c* in Fig. 258, p. 726, so that only a thin surface of perineum is left, the vaginal mucous membrane may be united by one or two sutures.

Lacerations not dividing the Sphincter Ani.—A laceration not dividing the sphincter ani may be closed by sutures almost immediately after delivery. The use of an anæsthetic is not essential, if the patient is tolerant of pain. But an anæsthetic may be given, if there has been no excessive hæmorrhage, if the uterus is well contracted, and about an hour has elapsed since the delivery of the fœtus, the placenta having been also delivered. A pad of cotton, or a perfectly clean sponge, may be placed in the vagina to dam back the sanguineous discharge, while the stitches are being passed. The best materials for sutures are fishing-gut and silver wire. Of these, the former has the advantage that the ends are not so likely to cause discomfort. But it is better to use ordinary sewing silk than to leave the laceration ununited. A straight needle, about an inch and a-half long, held in a needle-holder, is the best to use if no anæsthetic is employed. But the sutures can be applied still more conveniently by means of Hagedorn's needle-holder and curved needles (Figs. 259, 260), the needles being flattened at the sides. The needles being larger, give somewhat more pain, but, if an anæsthetic is used, they have a distinct advantage. The circular curved needles should be chosen. The stitches may often be inserted without moving the patient from the lateral position in which she is lying. But the operation is easier if she is placed on her back, the trunk transverse to the bed, and, if her feet are rested on a couple of chairs, the operator standing between them. The labia may then be separated somewhat by the

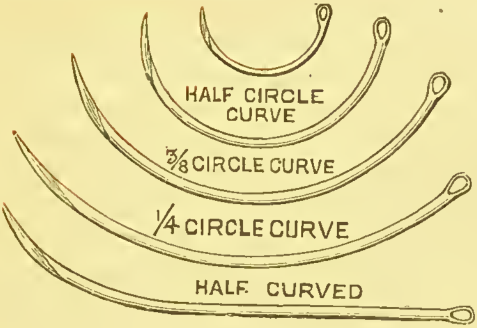

Fig. 259.—Hagedorn's needles.

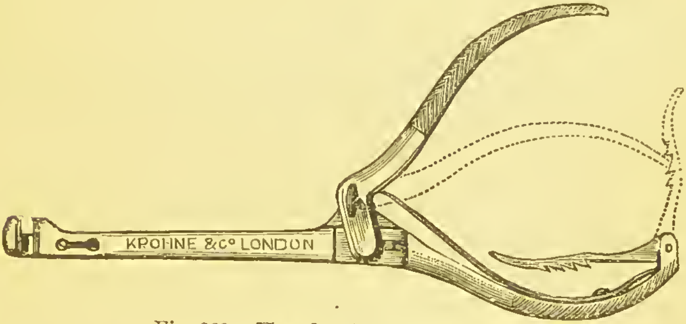

Fig. 260.—Hagedorn's needle-holder.

nurse. The needle should be passed through the whole thickness of the perineum, entering about a quarter of an inch from the edge on the cutaneous surface, and emerging as nearly as possible on the edge of the vaginal mucous membrane, the central part of its course being the deepest. On the patient's left side the needle is passed from without inward, and on the right side from within outward, and the loop of suture is thus completed. In general two sutures are sufficient. The mode in which they may be applied for a laceration extending up to the sphincter is shown at 1 1′, 2 2′, in Fig. 258, p. 726. An error specially to be avoided is to unite the perineum too superficially, not carrying the needles through to the vaginal mucous membrane. A thin perineum, useless as a vaginal support, is then likely to result.

If sutures are thought desirable in any case of laceration affecting only the vaginal side of the perineal body, as along the line *f c* in Fig. 258, and not reaching the perineum proper, one or two may be applied within the vagina by means of a curved needle, held in a needle-holder. Hagedorn's needle-holder and needles are the best in this case also.

The vaginal irrigator should be used as usual. The patient may also be allowed to pass her urine as usual, but it is a good plan to have the irrigator used, and the genitals washed, immediately after she has done so. After the first day or two, she may pass urine in the kneeling position. The sutures should be removed in about a week.

Lacerations dividing the Sphincter Ani.—When the sphincter ani is divided, the sutures should be applied in the same way as in the gynæcological operation for ruptured perineum.* Sufficient time after delivery should be allowed to elapse to obviate the risk of hæmorrhage, say at least an hour. An anæsthetic should be given, and there should be an assistant to administer it. Ether should be chosen rather than chloroform, that the relaxing effect upon the uterus may be less.

Two or more stitches may be used to unite the rectal mucous membrane, the knots being tied on the rectal side. Then, by means of a Hagedorn's needle, one suture is passed completely round from side to side, through the remains of the septum, being buried throughout its course, the ends being close to the anus at each side. The remaining perineal sutures, three or four in number, are to be placed in front of this. As in the former case, the needle should be passed about a quarter of an inch from the edge of the rent on the perineal side, and as close as possible to the edge on the vaginal side. Hagedorn's needles are the best for these sutures also. The rectal sutures may be of chromicised gut, and may then be cut short and left to become eventually absorbed. Some operators prefer to unite by sutures the edges of the vagina as well as those of the perineum and rectum, and so form a "three-plane suture." The perineal sutures are then not placed so deeply. Either of these methods is preferable to that of using the quilled or button suture. This causes swelling and inflammation of the tissue by interfering with the circulation. Hence there is greater pain afterwards, and it often becomes necessary to remove the deep sutures prematurely.

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* For full description and figure of the operation, see the author's "Student's Guide to the Diseases of Women," fifth edition, pp. 464—470.

In a rupture dividing the sphincter, it is well to keep the bowels confined for three days, and to give a little opium for this purpose, in order to allow time for primary union. It is a mistake, however, to keep the bowels locked up for a week or ten days, for the collection of hard fæces is then apt to break down the union. At the end of three days three or four ounces of olive oil should first be injected into the bowel, and a few hours later a soap enema should be given. From this time the bowels should be kept acting daily by a very gentle laxative. Until the bowels have acted, the diet should be sparing, and consist mainly of milk. The catheter may be used for the first two or three days, until the patient is able to pass urine in a kneeling position. After each action of the bowels the perineum should be carefully cleansed by means of a syringe, and may be dusted over with iodoform. The perineal sutures should be removed in about seven days. It is well at first to take out alternate sutures only, and to leave the long suture encircling the septum, and one or two others, for two days longer.

Laceration of the Vulva.—Lacerations may take place, not only at the posterior surface but at the sides of the vulva or near the clitoris. They are generally parallel to the axis of the vagina, that direction being perpendicular to the line of greatest tension. Some hæmorrhage after delivery may arise from such lacerations, especially if the plexus of veins at the side of the vestibule is torn.

Treatment.—Hæmorrhage may be arrested by pressure, or by bringing together the edges of the laceration with one or two sutures.

Rupture of the Pelvic Articulations.*—The relaxation of the pelvic articulations which occurs in pregnancy in very varying degree has already been described. Actual separation at the joints sometimes occurs in labour. When preceded by excessive relaxation of the joints before delivery, this sometimes happens under the influence of the natural expulsive forces only. More frequently it is produced by efforts at artificial extraction, especially in the high forceps operation. The joint may then sometimes give way with an audible crack.

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* See Ahlfeld, "Die Verletzungen der Beckengelenke," &c. Schmidt's Jahrbuch, Bd. 169. 1876.

The joint most frequently ruptured is the symphysis pubis. The separation may take place at the symphysis itself, or the cartilage may be broken away from one pubic bone. For any space in the pelvis to be gained by the rupture, it is inevitable that some rupture should take place also at another of the pelvic joints. Accordingly, with rupture at the symphysis pubis there is commonly combined some separation at one or both sacro-iliac joints, but the experience of symphysiotomy shows that this is not usually of serious consequence. Usually the anterior part of the joint alone is separated, the posterior remaining intact. With the rupture of the symphysis pubis may be associated laceration of the anterior wall of the bladder, the anterior vaginal wall, or the urethra.

The accident occurs most frequently when there is lack of transverse space, as in the uniformly contracted pelvis. The effect of traction is then to drag the pubic bones directly apart. In the flattened pelvis this is not the case.

Diagnosis.—There is pain and tenderness in the situation of the affected joints, and inability to move the legs. Pain in the joints is produced by pressure on the innominate bone. On bimanual examination the mobility of one pubic bone on the other may be detected. According to Ahlfeld the thighs are everted.

Prognosis.—In the majority of cases the result has been favourable, unless septic infection has resulted in consequence of other lesions due to the difficulty of labour. Generally the joints have become consolidated again. In some cases, when the joints have not been kept at rest, abscesses have formed at the site of rupture.

Treatment.—A firm, strong binder should be placed round the pelvis, and the patient should be kept at rest in bed longer than the usual period, until the tenderness in the joints has subsided. She should still wear a binder round the pelvis, when beginning to get about, until freedom of locomotion is restored.

PRESENTATION, PROLAPSE, AND EXPRESSION OF THE FUNIS.

The funis is said to present when, before rupture of the membranes, it is felt in front of, or in conjunction with, any other presenting part. Under such circumstances, as soon as the membranes rupture, a loop of the funis generally descends through the os, or can be felt by the side of the head or other presenting part. The funis is then said to be prolapsed. Prolapse of the funis may also occur for the first time at the moment when the membranes 2 rupture, a loop of it coming down with the escape of the liquor amnii. There is yet a third mechanism by which prolapse of the funis may originate, one which is more properly called expression of the funis. In this case the funis does not drop down passively, but is expelled by the intra-uterine pressure through some space left 3 between the child and the lower segment of the uterus.* The prolapse then usually takes place for the first time at a considerable interval after the rupture of the membranes, labour being obstructed by disproportion between the child and the pelvic brim. The same mechanism of expression may, however, come into action after the funis has been artificially returned into the uterus in a case in which the first prolapse was of a passive character.

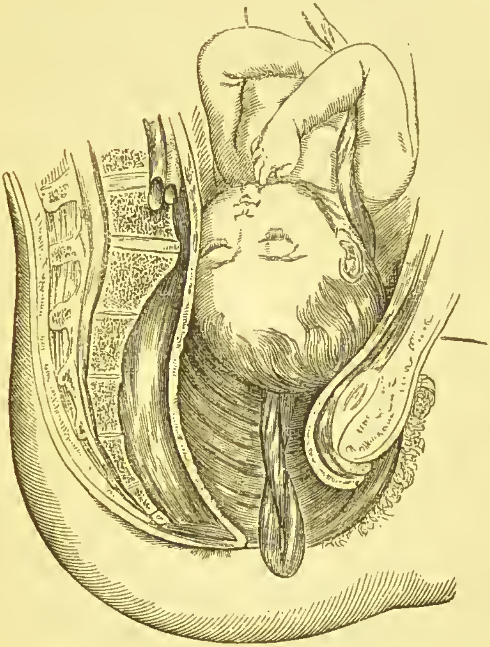

Fig. 261.—Prolapse of the funis, with the head in the first position.

Causation.—The reason why prolapse of the funis does not take place more often is that the lower segment of the uterus is occupied by the head, which is closely adapted to it. Hence the most important cause of prolapse of the funis in head presentation is deformity of the brim, especially flattening of the brim. This FLA prevents the head from descending low enough into the pelvis to rest closely upon the cervix during dilatation, while vacant space is left opposite the sacro-iliac synchondroses through which the funis can descend. (See Fig. 181, p. 528.) In pelvic and still more in transverse presentations prolapse of the funis is also promoted by the fact that the presenting part does not so accurately fill up the cervix as the head would do, and that the umbilicus, in these cases, is nearer to the os uteri. (See Fig. 171, p. 492.) Other causes predisposing to prolapse are excessive length of the funis, low insertion of the placenta, low implantation of the funis in battledore placenta, and excess of liquor amnii. Prolapse is commoner in parous women than in primiparæ, since in the latter the greater tonicity of the abdominal walls keeps the head more closely adapted to the brim.

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* See Roper, Obstet. Trans. Vol. XVII.; Matthews Duncan, Obstet. Trans. Vol. XXI.

Frequency.—The frequency varies considerably in different countries, and in different lying-in institutions. The occurrence is probably commoner in those places where pelvic contraction is frequent. The frequency has been variously estimated at from 1 in 70 to 1 in 400 deliveries. In the Guy's Hospital Charity (1863—1875) it was 1 in 383 deliveries. Churchill's statistics give a frequency of 1 in 245 deliveries.

Diagnosis.—There is scarcely anything which can give rise to error of diagnosis except fœtal intestine in a case of ectopia of viscera. When the funis is felt to pulsate diagnosis is perfectly easy, even before rupture of the membranes. If the funis is pulseless and flaccid, it may generally be inferred that the child is dead. The child may, however, be capable of resuscitation for a short time after the funis has ceased pulsating, and therefore the fœtal heart should always be listened for, to complete the diagnosis. Pulsation may also be arrested for the time by a pain, to reappear during the interval. If the pulsation becomes progressively slower, it is a sign that the child's life is becoming endangered.

Prognosis.—The prognosis is very unfavourable for the child, especially in head presentations. The mortality in general is at least 50 per cent., but it varies much according to the stage at which a case first comes under observation, and the treatment adopted. In pelvic presentations the danger is considerably less. There is no danger to the mother, except such as may result from efforts to save the life of the child.

Treatment.—*Before rupture of the membranes.*—In the first stage of labour, the great object is to defer the rupture of the membranes until the os is quite fully dilated. For this purpose the patient should be kept recumbent, and directed to avoid any bearing-down efforts. She may be placed in the semi-prone position, on the opposite side to that on which the funis has descended. No attempt should be made to push back the funis through the membranes. The attempt is not likely to succeed, and may possibly cause rupture of the membranes. The only method of restoration which may be attempted with advantage at this stage, provided that the fœtus is alive, is the postural method. If the woman is placed upon a firm mattress in the knee-elbow position, so that the thighs are exactly vertical, and the chest as close as possible to the surface of the mattress, the brim of the pelvis, and therefore the fundus of the uterus, will be directed almost vertically downward. The funis will then tend to gravitate away from the os. The patient should be kept in this position during two or three pains. If recession of the funis is thus obtained, she may be turned into the semi-prone position previously described.

As a rule the funis is not exposed to pressure as long as the membranes are unruptured. In exceptional cases, however, it may be so, when the os is so far dilated as to allow onward movement of the presenting part through the cervix to take place, even without rupture of the membranes, as in such a case as that represented in Fig. 72, p. 155. The ring of close contact which sometimes divides the "fore-waters" from the rest of the liquor amnii may then compress the funis. Under such circumstances, if either the pulsation of the funis, or the rate of the fœtal heart, is found to be becoming slow, the membranes should be ruptured, and the case treated by one of the methods shortly to be described.

Reposition of the funis.—If, after rupture of the membranes, the funis is found without pulsation, and no fœtal heart can be heard, no treatment directed to the prolapse should be adopted. If, however, the funis pulsates, if the os is fairly dilated, and if the vagina readily allows the introduction of the hand, an attempt should be made at manual reposition of the funis. Advantage here also is gained by putting the patient in the knee-elbow position. The hand should be passed within the cervix, laid flat against the head, and the loop of funis pushed up by the tips of the fingers until the whole of it is completely above the head. If a limb can readily be felt, a part of the loop may be hung over it. If a pain comes on the hand should remain quiescent until it has passed off. Then the other hand should be used externally to press the head down into the brim. At this stage the patient may be turned into the semi-prone position, the internal hand gradually withdrawn, and the pressure of the external hand maintained until a pain comes on, and assists in fixing the head in the brim. This method is likely to succeed, unless, through deformity of the pelvis, there is a space, by which the funis may again come down. If the patient cannot readily be induced to adopt the knee-elbow position, the semi-prone position may be used from the first with almost as much advantage. This method of reposition is useless if the case is one of expression of the funis at a considerable interval after rupture of the membranes, or if the funis is found to come down again after complete reposition. The only chance for the child is then to extract as quickly as possible.

Extraction by forceps or version.—If the funis cannot be replaced by the hand, or descends again after reposition, or if the hand cannot readily be passed into the vagina, the best plan is to extract by forceps or version as rapidly as is possible without risking injury to the mother. It is still assumed that the os is fairly dilated. Forceps should be preferred if the dilatation is so complete that the cervix is not likely to delay delivery, otherwise version may be performed. After the foot has been brought down, the funis should be replaced, if possible, within the uterus, and the half-breech at once drawn down into the os, so as to fill up the space. If this can be effected, delivery need not be hurried. If a loop of funis still remains prolapsed by the side of the breech, delivery must be hastened by traction upon the leg, a watch being kept upon the pulsations of the funis.

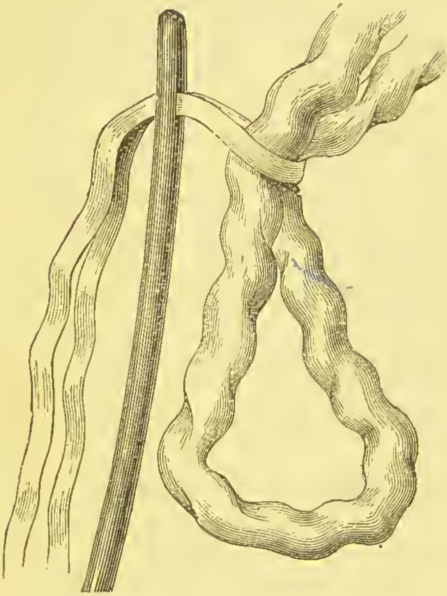

Fig. 262.—Gum-elastic catheter adapted as funis-repositor.

Instrumental reposition.—The case for which the use of a repositor is most suitable is that in which the membranes rupture before the os is much dilated. It may also be tried, in the place of manual reposition, in primiparæ and others in whom a narrow vagina renders it difficult to introduce the hand. A repositor may be improvised in the following manner:—A large-sized gum-elastic catheter is taken, a slit is cut near the end of it opposite the eye, and a loop of tape passed through the eye and the artificial slit (Fig. 262). A loop of funis is then secured in the tape, but not so tightly as to compress it. The stylet is introduced into the catheter, and by its aid the catheter is passed nearly its whole length into the uterus, until the funis is quite out of reach. The stylet is then withdrawn, and the catheter left in place until after the delivery of the head. Roberton's funis repositor is a rod of gutta-percha, having a hole near the end, and is intended to be used in the same way. It has the advantage of being longer than an ordinary catheter. A long piece of whalebone may also be used in the same manner, a hole being cut near the extremity.

Treatment in pelvic presentations.—In breech presentations one leg should be brought down. It is useful to fasten a noose of tape round the foot. The funis should then be pushed up as far as possible into the uterus, and, by means of the tape, the half-breech drawn down into the os, so as to fill it up, before the internal hand is withdrawn. If this does not succeed, labour must be accelerated by traction on the leg.

PHYSOMETRA OR TYMPANITES UTERI.

Air may gain access to the uterus during obstetric operations, especially when the hand is introduced into the uterus for version, or to guide the application of extracting instruments in craniotomy. Under these circumstances, if the child is becoming somewhat asphyxiated from prolonged pressure, it may attempt to breathe, and even to cry, producing the so-called *vagitus uterinus.* I have met with a case in which such a cry was heard during version performed on account of contraction of the brim. The child was still-born, but, on post-mortem examination, partial distension of its lungs was found, such as would generally be considered as proof of live-birth. This medico-legal test of live-birth is therefore open to possible fallacy under these circumstances.

Even without the performance of any operation, air may enter the uterus in smaller quantity, replacing some of the liquor amnii. When, after long rupture of the membranes, the greater part of that fluid has drained away, and air has entered, carrying with it septic germs, the air sets up decomposition of the fœtus soon after its death, and decomposition goes on rapidly in presence of warmth and moisture. It is still further promoted if free entry of air has taken place in attempts at operation. From decomposition fœtid gas may be freely produced, and if, at the same time, the uterus is inactive from exhaustion, it may become distended and tympanitic. Such a condition is always a grave one for the patient, and generally indicates that interference has been too long deferred. The presence of air or gas within the uterus involves the possibility of sudden death through the entrance of the air or gas into the veins (See Chapter XL.).

Treatment.—The uterus should be emptied as soon as possible, and at once washed out with antiseptic fluid. All means should be taken to secure firm permanent contraction of the uterus. Uterine irrigations should be continued through the puerperal period, if there are any unfavourable symptoms.

Inversion of the Uterus.

In inversion of the uterus, the uterus becomes more or less completely turned inside out, so that its peritoneal surface becomes interior. Into the cavity thus formed is necessarily drawn more or less of the Fallopian tubes, ovarian ligaments, broad and round ligaments; sometimes also the ovaries themselves. Inversion may exist in three stages; in the first, the fundus is partially inverted, but does not pass through the external os; in the second, the inverted fundus passes through the os into the vagina, but the inversion is still incomplete; in the third, the inversion is complete, so that there is no longer any groove round the neck of the tumour formed by the inverted uterus. Either the second or third stage may be complicated by prolapse of the inverted fundus through the vulva. In other instances the inversion may begin, not at or near the fundus, but lower down in the uterine wall, and one wall may become inverted before the other. In this case, a section of the uterine wall forms an S-shaped curve, while the inversion is in course of production. Inversion may be produced either before or after the expulsion of the placenta.

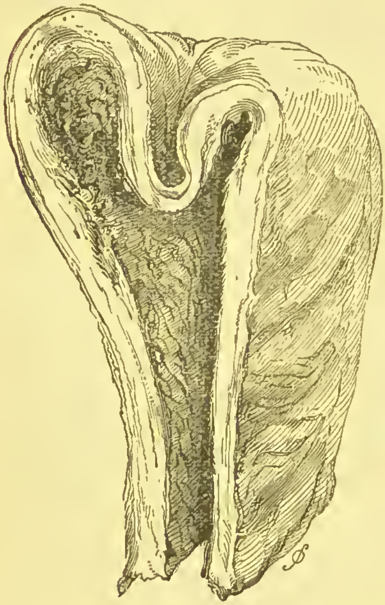

Fig. 263.—Commencing inversion of the uterus, from a preparation in the Museum of Guy's Hospital.

Causation.—For the production of inversion, it is essential that there should be inertia, either complete or partial, of the uterine wall. In some cases inversion is produced, or at any rate initiated, by the interference of the accoucheur. This may be done, when the uterus is relaxed, either by injudicious traction on the funis, the placenta being adherent, or by a too localised downward pressure upon the fundus employed either to expel the placenta, or to stimulate uterine contraction. In other cases inversion is entirely spontaneous. Here also there must be relaxation at any rate of the part of the uterine wall at which the inversion commences, often the placental site. A bulging inward may be the result simply of gravity, especially through the weight of a still attached placenta. Or it may be the effect of a bearing-down effort, especially when made in an upright position, as for micturition or defæcation, shortly after delivery. Such a bearing-down effort may complete the inversion, if the uterus is entirely relaxed. But it appears that, in spontaneous inversion, a partial contraction of the uterus itself often aids in the process. The relaxed and partially inverted fundus, bulging into the cavity, excites the lower part of the uterus to contract, as a foreign body would, and by this means is expelled through the os. The mechanism is the same as that by which a commencing intussusception is increased by intestinal contraction. The patient also feels the sensation as of a foreign body which has to be expelled, and is thereby stimulated to a bearing-down effort, which aids in completing the inversion.

The bulging inward of the placental site, which is the first step towards inversion, may be produced even before delivery in consequence of shortness of the funis, either absolute or due to the funis being twisted round the neck. This will happen the more readily if delivery is aided by forceps. Its spontaneous occurrence must generally imply some irregularity in the uterine contraction, since a firm contraction of the whole fundus renders inversion impossible. If, however, delivery takes place in an upright position, inversion may be produced by the weight of the child acting through the funis, while the uterus is relaxed. An insertion of the placenta exactly at the fundus, instead of on the anterior or posterior uterine wall, has been thought to be a predisposing cause of inversion, since the relaxed placental site is then more likely to bulge into the uterine cavity like a polypus. Inversion generally happens very soon after delivery, and more frequently before than after the expulsion of the placenta. If observed at a later stage, it is more generally gradual in its production. I have met with a case in which it was produced two days after delivery as the patient was sitting up to pass urine. But in cases of this kind it is probable that a partial inversion may have existed from an earlier stage. Inversion has been recorded after delivery in the earlier months of pregnancy, but much less frequently than at full term. Apart from pregnancy, it may be produced by traction of a tumour.

Frequency.—Inversion of the uterus is very rare. Only one case was observed in 190,000 deliveries at the Rotunda Hospital, Dublin.

Symptoms and results.—The symptoms of inversion are shock and hæmorrhage. The shock is due mainly to the strangulation of the uterus and the traction on the broad ligaments. It is shown by pain, rapid feeble pulse, anxious expression, and often vomiting. The hæmorrhage is due partly to the uterine inertia, which allowed the inversion, partly to the strangulation impeding the return of venous blood from the fundus. If the inversion is produced gradually, shock is less manifest, and hæmorrhage the main symptom. If the inversion is left unrestored, hæmorrhage is apt to persist and recur, especially when menstruation recommences. I have known a woman to remain free from hæmorrhage or other symptoms for many months as long as she was suckling, but to begin to suffer from serious hæmorrhage as soon as she weaned her baby. More or less inflammation of the surface of the inverted uterus also follows. Hence arises semi-purulent discharge, and sometimes sloughing and septicæmia. The presence of the tumour in the vagina also sets up bearing-down efforts, with rectal and vesical tenesmus. Eventually, in some cases, toleration is established to a great extent, and women have lived for many years with an inverted uterus. But death may result from hæmorrhage even at a considerable interval after the first occurrence of the accident.

Prognosis.—In a considerable proportion of cases death results from hæmorrhage aided by shock, generally within half-an-hour or an hour after the accident. According to Crosse,* a fatal result follows within a few hours in about 28 per cent. of the cases, sooner or later in about 42 per cent. In about 7 per cent. death took place after more than a year's interval.

Diagnosis.—In recent inversion diagnosis is easy. Before the separation of the placenta no mistake can possibly be made. After its separation, the inverted uterus could only be mistaken for a fibroid tumour or fibroid polypus. It is distinguished from these by the absence of the fundus uteri from its normal position in the hypogastrium. The diagnosis may be made by abdominal examination alone if the accoucheur, on placing his hand on the abdomen shortly after delivery, fails to feel any fundus uteri; but can pass his hand down deeply, and feel the promontory of the sacrum. It will then be easily verified by vaginal examination. If any unusual pain, or symptoms of shock, or hæmorrhage is observed shortly after delivery, a vaginal examination should never be omitted; otherwise an inversion of the uterus, partial or even complete, may be overlooked. The diagnosis in the chronic stage belongs to gynæcology.

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* "An Essay on Inversio Uteri." Trans. of the Provincial Med. and Surg. Assoc. 1847.

Treatment.—If the case is recognised at once, reduction should be effected as soon as possible, without more delay than is necessary to give some brandy, or a subcutaneous injection of ether, if there is great collapse. If the placenta is still attached, it should be peeled off first, because the size of the mass to be returned is by that means considerably reduced.

In carrying out the taxis, counter-pressure is to be made with the external hand, to prevent too great stretching of the uterine attachments. The fundus should not be indented, for then four thicknesses of the uterine wall instead of two would have to be passed through the cervix. The uterus should be returned in the same way as that in which it came down. For this purpose, the fundus may be grasped in the palm of the hand and pressed upwards. When it has been elevated as far as possible in this way, pressure may be made upon the fundus with the closed fist. At each stage, the direction of pressure must be that of the pelvic axis. If resistance is met with at the final stage, after the fundus has been returned through the external os, advantage may be derived from the method recommended by Noeggerath, namely, to make pressure with one or two fingers near the orifice of the Fallopian tube, and so restore one corner of the uterus first. If the reduction is prevented by contraction of the cervix, an anæsthetic should be given, if the condition of the patient will allow it, and the operation will thus be greatly facilitated.

If the inversion is only discovered at some interval after delivery an attempt at reduction by taxis, with the assistance of an anæsthetic, may still be made, if involution has not progressed far. If the attempt fails, the case must be treated as one of chronic inversion. The same plan may be adopted from the outset, if involution has already progressed far, and the base of the uterine tumour appears to be small and firmly contracted. Inversion is regarded as chronic, when the process of involution has become complete.

Elastic pressure.—The best treatment for chronic inversion is gradual elastic pressure by means of Aveling's repositor. This consists of an S-shaped stem with double curve, pelvic and perineal, surmounted by a cup which receives the inverted fundus. (Fig. 264.) By means of this repositor pressure can be made always in the correct direction, along the pelvic axis, just as axis-traction is made by Tarnier's forceps, which it resembles in shape. The pressure is exercised by four elastic rings, fastened by bands to a waist-belt, which is again supported by shoulder straps. By means of these, the direction and degree of the pressure can be exactly regulated. The instrument is made with cups of two or three sizes, which can be screwed on at the top. The largest cup is used while the inverted fundus is in the vagina. It may be changed for a smaller one when the fundus has passed up to the level of the vaginal roof. There is one drawback to Aveling's instrument, namely, that the restoration is often suddenly completed in the middle of the night. When the patient is visited the next day, the internal os has contracted beneath the shallow cup, and there is much difficulty in extracting the cup out of the uterus. To obviate this I have had a modification of the instrument constructed in which the smaller cup forms the summit of a cylinder $1\frac{3}{4}$ inches long. When the restoration is complete, the cylinder keeps the internal os dilated, and is easily withdrawn. The external os docs not contract for a few hours. The cylinder is also perforated by a

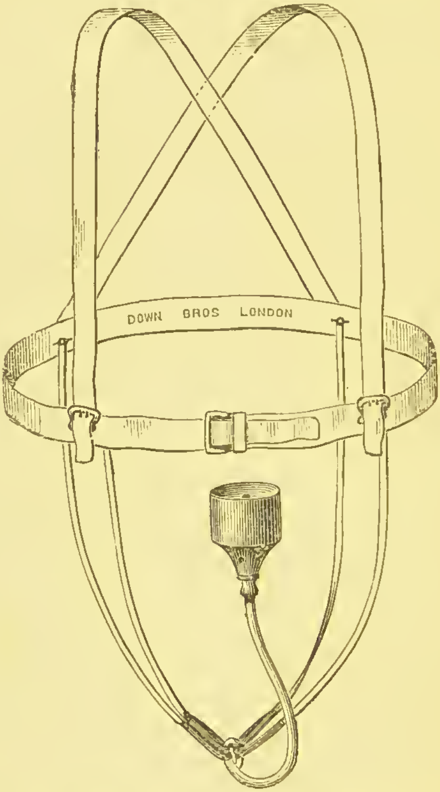

Fig. 264.—Modified Aveling's repositor for inversion of uterus.

small hole, to prevent its withdrawal being hindered by atmospheric pressure.

The position in which the instrument lies, when the bands are tightened up, is shown in Fig. 265, p. 743. The bands may require further tightening, after a few hours, as the uterus ascends; and sedatives must be given, if much pain is produced. In a considerable number of cases the inverted uterus has been amputated, when reduction has been found impossible. It is probable that this will hardly ever prove necessary if a fair trial is given to elastic pressure with a proper repositor. I have never known restoration fail to be completed within 48 hours.

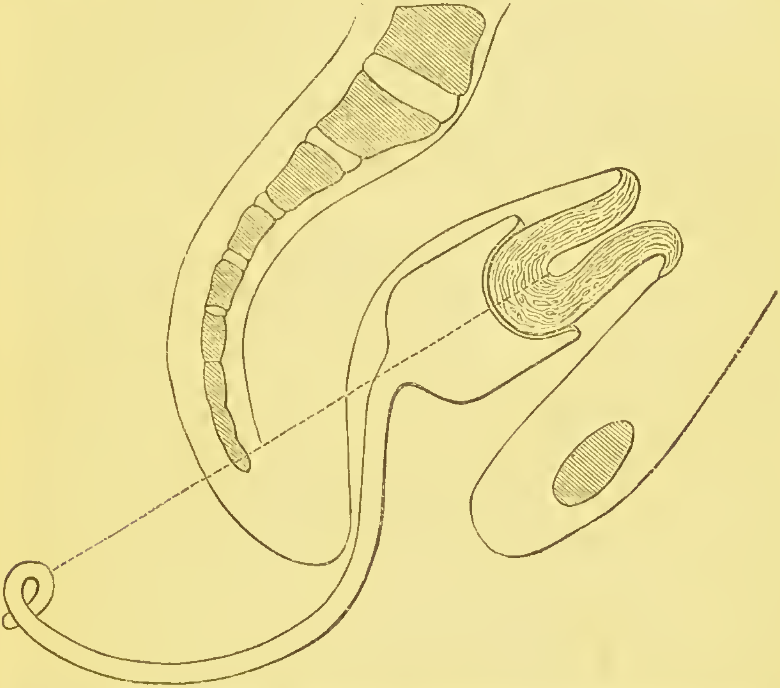

Fig. 265.—Modified Aveling's repositor applied for reduction of inverted uterus.

In the absence of an Aveling's repositor, restoration may not improbably be effected at an early stage, before involution has proceeded very far, by the pressure of a hydrostatic dilating bag, introduced into the vagina and distended.

ASPHYXIA NEONATORUM, OR SUSPENDED ANIMATION OF THE NEW-BORN INFANT.

Normally the new-born infant not only breathes freely, but cries loudly, immediately after its expulsion. The deep inspirations which it makes in crying are of service in fully expanding for the first time the previously airless lungs. The cause of the first inspiration is partly that the aeration of the blood is interrupted by detachment of the placenta, and partly that the cold external air acts as a reflex stimulus upon the skin. Under certain circumstances, the child is born apparently lifeless, or in a state of suspended animation, and makes no attempt to breathe, although the heart is still beating to some extent. In other cases, it makes ineffectual gasps at intervals.

Causation.—There are two main causes of the state of suspended animation :—First, interruption of, or obstruction to, the aeration of the blood by the placental circulation ; secondly, pressure upon the head. Interference with aeration of the blood may take place in various ways. The placenta may be partially or wholly detached. The circulation through it may be impeded by prolonged contraction of the uterus, especially when the liquor amnii has long escaped, the uterus closely grasps the child, and has passed into the state of continuous contraction. The funis may be compressed when prolapsed or coiled round the neck, or in pelvic presentations. (See p. 252.) Circulation may also be impeded by pressure upon the thorax or neck of the child, especially when the head has been expelled, and the trunk is retained within the vulva. Again, deficient aeration of blood may be the result of profuse hæmorrhage from the mother, and may be promoted also by poorness of quality, or other morbid condition, of the maternal blood apart from hæmorrhage.

The first effect of deficient aeration of blood is that the respiratory centre is stimulated, and the child makes futile efforts to breathe. This is proved by the fact that, in many cases, mucus and liquor amnii are found *post mortem* to have been drawn into the bronchi and lungs, and extravasations of blood in the lungs to have been produced by the suction due to attempted inspiration. It is under such circumstances that, in rare cases, the *vagitus uterinus,* or intra-uterine cry, of the child has been heard, when air has been admitted into the uterus in the course of turning or some other obstetric operation. The child being unable to obtain air, the heart's action becomes slower and gradually fails, and eventually the irritability of the respiratory centre is impaired or destroyed from the lack of a supply of suitable blood. When the child is born in this condition, the stimulus of the external air fails to excite any attempt to breathe, or calls forth only feeble gasps.

Prolonged pressure on the fœtal head in difficult labour also eventually causes impairment, and at last destruction, of the irritability of the respiratory centre. In general, prolongation of the pressure appears to be the chief element in the case. But it is possible that a more severe, although shorter, pressure may have a similar effect. This may be the reason why a frequent and early use of forceps appears, from reliable statistics (see pp. 450, 451), to have such a slight influence in diminishing the ratio of still-births, and one so much less than has been imagined by various modern authors. In head-last deliveries, when the medulla oblongata is exposed to injury, as by excessive traction on the neck, the respiratory centre, or its connections with the nerves, may be altogether destroyed.

Symptoms and diagnosis.—Before delivery, if the fœtal heart or pulsation of the funis is found to be becoming gradually slower and more feeble, it is a sign of impending asphyxia. Temporary retardation of the heart is generally a sign of temporary pressure on the funis. In head-last deliveries asphyxia is indicated by attempted inspirations, or convulsive movements of the limbs.

After delivery, the symptoms vary according to the degree of the asphyxia. In mild cases, the appearance of the child is generally livid and cyanotic, especially that of the head, if there has been pressure on the neck. There is some tonicity of the neck and limbs. The heart's action is obvious, and some pulsation may be felt in the funis. There may be spontaneous attempts at breathing. These generally take the form of deep inspiratory gasps, due to contraction of the diaphragm, which have more effect in sucking in the ribs than in drawing in air, owing to the obstruction produced by the fluid which has been drawn into the air-passages. They are accompanied by facial contortion. If breathing becomes established, naturally or after the use of artificial means, rapid and very shallow diaphragmatic breathing generally begins to continue between the deep gasps, some time before the gasps themselves cease, or the child gains vigour enough to cry.

If any air is inspired, the short inspiration is followed by a prolonged expiration, the bronchi being obstructed by the fluid which has been drawn in.

In the graver form of asphyxia the skin is pale instead of livid, and the neck and limbs have lost all tonicity. There is generally no spontaneous attempt at breathing, unless artificial means are used. No pulsation is felt in the funis, and the heart's action may be very feeble and at long intervals. The pulsation of the heart is always visible, while any pulsation continues, and should be looked for, not listened for. This form of asphyxia is specially likely to arise from prolonged pressure on the head.

Prognosis.—While there is any action of the heart, however slow and feeble, there is always hope that the child may be resuscitated. If the heart has ceased beating, it is useless to attempt any treatment. If the child makes any spontaneous gasp, either shortly after delivery or while artificial respiration is being carried out, it is almost certain that treatment will be successful in reviving it, if persevered with long enough. There may, however, be exceptional cases, as when the larynx has been injured by unskilful attempts at jaw-traction, or by compression with the forceps in cases of face or brow presentation. If there is no spontaneous attempt at inspiration, it may happen that, although the heart's action may be maintained for an hour or more, and even improved, by artificial respiration, yet the child cannot be induced to breathe. In such cases the respiratory centre has probably undergone irreparable injury. In some instances, although breathing is established, and the child may even cry, yet it remains feeble, and dies within a few days. In such cases the condition called *atelectasis pulmonum* is often found *post mortem.* The lungs are shown to have been only imperfectly expanded, and a considerable proportion of them still remains solid and airless. This is especially likely to be the case where the child is feeble or premature. With feeble and premature children the same condition of atelectasis may be found, if the child dies within a few days, even if it has breathed spontaneously from the first. A vigorous cry is the most effectual means of fully expanding the lungs.

Treatment.—If the child does not breathe freely and cry immediately after delivery, the first thing to be done is to clear away, as far as possible, any inspired mucus which may be obstructing the air-passages. The child should be turned for a moment with its face downward, and the back of the mouth wiped out with a clean napkin. The next effort should be to stimulate respiration by reflex stimulus. This may be done by blowing upon the child's face, and by flapping its buttocks, back, or chest with a towel wetted in cold water. An effectual plan is to have two basins, one filled with hot, the other with cold water, and to dip the child for a moment into each alternately, repeating this several times. Artificial respiration may be performed, if necessary, while the basins are being prepared. If, however, the asphyxia is of the graver form in which the face is pallid and tonicity is lost, time should not be wasted in attempts to excite respiration by reflex stimulus, but artificial respiration should be performed at once.

If the child does not respond to the first attempts to excite respiration, such as flapping it with a towel, the funis should be tied in two places and divided, in order to allow the means for resuscitation to be carried out more readily. If, however, pulsation can be felt in the funis, as will be the case only in the milder forms of asphyxia, artificial respiration may be tried for a few minutes before the child is separated. It is generally advised that, if the child appears cyanotic, a little blood should be allowed to escape from the fœtal end of the cord, before the ligature is tightened. This does not appear to be good practice. The cyanotic form of asphyxia is not the most serious (see p. 745), and the cyanosis very quickly passes off if the child can be induced to breathe. Moreover, it is to be remembered that the early ligature of the funis, which is inevitable when the child is asphyxiated and no pulsation can be felt in the funis, is itself equivalent to bleeding the child to a considerable extent. To allow any further loss of blood appears, therefore, undesirable, since a child asphyxiated at birth sometimes dies within a few days from feebleness and atelectasis pulmonum.

Artificial respiration.—If response does not soon take place to reflex stimulus, or without delay in the pallid form of asphyxia, artificial respiration should be performed. The most effectual method is a slight modification of that of Silvester. To carry it out to perfection an assistant is required to fix the legs of the child. As the nurse will generally be wanted, to keep her hand upon the uterus while the physician is attending to the child, some other person should, if possible, be called into the room to assist. The child is placed on its back, the head supported, but moderately extended, so that the chin is not pressed upon the sternum, the thorax being slightly raised by a napkin placed underneath ; the assistant holds the feet firmly in a napkin. The physician stands behind the child's head.

To imitate inspiration, he grasps the arms near the elbows, raises them from the sides and brings them near together above the head, at the same time making gentle traction upwards. It is in order to make counter-traction at this time by holding the feet that the assistant is required. During this movement the arms should be somewhat everted, so as to put the pectoralis major more upon the stretch. This movement very effectually expands the ribs. The effect is indeed expended, in the new-born infant, more in sucking in the abdomen, through the medium of the diaphragm, than in drawing in air. But by repetition of the movement more and more air gradually gains access to the lungs.

To imitate expiration, the elbows are brought down and pressed against the sides, and the arms somewhat inverted, so as to bring the fore-arms across the chest. By means of the fore-arms and the operator's hands pressure is made upon the chest and abdomen, as well as upon the sides, so as to squeeze out any air that may have been inspired, and, with it, some of the fluid which has entered the air-passages. The movements should not be made too rapidly. Twenty times in the minute are quite sufficient. After a few movements the back of the mouth may again be wiped clear of any mucous or liquor amnii which may have been expressed. If any attempt at spontaneous inspiration is made, great care should be taken so to time the movements as not to counteract but to aid it; for the contraction of the diaphragm is of more avail than the artificial movements in drawing in air, especially if it occurs while the ribs are expanded by means of the arms; and if once the lungs have become partially aerated, the artificial respiration becomes much more efficacious. When the attempts at breathing become more frequent, recourse may be had again to the plan of reflex stimulation. As soon as regular breathing, however shallow, begins to intervene between the spasmodic gasps, the artificial respiration may be discontinued in confidence that the natural breathing will steadily improve.

The efficacy of this method is shown, not only by the frequency with which children are revived by it, and by experiments upon stillborn children,* but by the fact that the heart's action can often be by this means maintained for a long time, and even quickened, and the colour of the skin improved, even though the irritability of the respiratory centre is lost past restoration. As a rule, however, the improvement of the heart's action is a hopeful sign, though not so significant as the commencement of spontaneous gasps.

In the absence of an assistant this method cannot be carried out to the full extent. The elbows may be simply raised above the head, but scarcely any upward traction upon them while in this position can be made. The absence of such traction seriously diminishes the efficacy as regards the expansion of the ribs. The movements may therefore be made more quickly, in order to compensate in some measure for this.

Tracheal insufflation.—The plan of direct insufflation of the lungs through the trachea has been more used abroad than in this country. It has the disadvantage that rupture of the air-cells may be caused by the force used. On the whole, therefore, it is not so much to be recommended as Silvester's method. It may, however, be tried if other means fail. My own experience has not been that it succeeds when Silvester's method does not. In France, insufflators made for the purpose are used, having a curve corresponding to the child's mouth, and a conical extremity to fit closely into the larnyx. With these, an indiarubber ball may be used for the insufflation. In the absence of an insufflator, a gum-elastic catheter, No. 6, may be used. This is guided by the tip of the finger behind the epiglottis and into the trachea, care being taken not to pass it into the œsophagus. First suction should be made to remove some of the inspired fluid, if possible, from the air-passages. With an insufflator, the suction is made by first emptying the indiarubber ball and then allowing it to refill by its own elasticity. The fluid in the trachea having been sucked out, the operator takes one or two deep breaths, to remove as much carbonic acid as possible from his lungs, and then blows gently into the tube. The chest is then compressed, to imitate expiration, and the same process is continued. Faradisation of the phrenic nerves has sometimes proved effectual, and may be tried as a last resort if a Faradic battery is at hand, but artificial respiration is generally preferable.

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* It has been shown by Champneys that in such experiments Silvester's method is found to be more efficacious for introduction of air than others which have been employed, such as those of Marshall Hall, Howard, Schultze, &c., especially if the arms are everted during the movement for inspiration. Med. Chir. Trans., Vol. LXIV.

CEPHALHÆMATOMA.—Besides the caput succedaneum another form of swelling on the head may result from difficult labour, namely, cephalhæmatoma, consisting of a circumscribed effusion of blood. Small effusions of blood may take place in the substance of the caput succedaneum, that is to say, in the cellular tissue beneath the scalp. But, in the characteristic form of cephalhæmatoma, the effusion takes place beneath the pericranium, separating it from the bone, and is due to the rupture of a considerable vessel. In some cases, blood is effused also beneath the bone, between it and the dura mater. Cephalhæmatoma most frequently results from the pressure of the blades of forceps; but it may be produced by pressure against any projecting bone, such as the promontory of the sacrum. It is also ascribed to the effect of pressure produced by an unyielding os uteri.

Diagnosis.—The swelling is limited to one bone, generally a parietal bone. It continues to increase for a time after birth, while a caput succedaneum diminishes progressively and rapidly from the time of birth. A cephalhæmatoma is generally first noticed from one to four days after birth. It may increase up to seven days, then remains for a few days stationary; and generally has disappeared after from four to twelve weeks. As a rule there is no discoloration of skin over the tumour. The tumour never crosses a suture, but in rare cases has occurred on both parietal bones. Fluctuation can generally be felt in it, until the serum has become absorbed. The swelling may or may not extend over the whole bone. After four or five days a hard border of inflammatory material begins to be felt round the edge, so that the feel somewhat resembles that of a depressed fracture. This is due to the formation of bony material along the edge of the detached pericranium. From this a thin crust of bone, which crackles on pressure, may extend over the swelling during the time in which the serum and clot are being absorbed. Encephalocele is distinguished by the fact that it always occurs in the line of a suture or at a fontanelle. There is no fluctuation, but the swelling generally pulsates, and enlarges when the child cries. A vascular tumour of the scalp gives no fluctuation; and there is generally discoloration of the skin over it.

Prognosis.—In general the effusion is absorbed in time. But, in a weakly or cachectic child, it may suppurate, and then may endanger life, sometimes leading to pyæmia.

Treatment.—The swelling should be left alone, unless there is evidence of suppuration.

OTHER INJURIES TO HEAD.—Local depressions on the head are generally due to the pressure of the sacral promontory. There may be either a spoon-shaped depression, or a more prolonged groove. In the latter case, if the head has passed in a position of flexion, the groove runs downward and forward near the anterior border of the parietal bone; if in a position of moderate extension, the groove is nearly parallel to the coronal suture. In some cases the groove first runs parallel to the suture and then turns forward, flexion having supervened upon extension at an intermediate stage. The position of the groove is similar in pelvic presentations, except that it is more often parallel to the coronal suture, passage in the extended position being relatively commoner. Depressions are more common in pelvic presentations, since the head is generally dragged quickly past the obstruction. Fissures of the bone, or actual fractures, are comparatively rare, but these again occur more frequently in pelvic presentations.

In flattened pelves, in consequence of the Naegele-obliquity, the posterior parietal and posterior half of the frontal bone are generally more flattened, the anterior more rounded than in normal labour, because the latter, projecting more deeply into the brim, are more unsupported. In general there is a "shear" or sliding movement of the anterior parietal bone upon the posterior in the direction of the occiput, but this must be produced after the occiput has begun to rotate forward, and is therefore more marked in the generally contracted pelvis.

APOPLEXY OF THE NEW-BORN.—Besides the hæmorrhage between the bone and dura mater, which sometimes accompanies cephalhæmatoma, intra-cranial hæmorrhage may occur independently. The hæmorrhage occurs more frequently from capillary vessels of pia mater than from arteries. In some cases the sinuses have been lacerated, generally with a fatal result. The cause is interference with circulation by difficult labour, pressure on the funis, or strangulation by the funis around the neck.

The child is generally born asphyxiated. If respiration is established, paralysis may be observed, either at once, or after the lapse of some weeks. Contraction of the limbs may follow, and intelligence is apt to be permanently impaired.

INJURIES TO NERVES.—Facial paralysis is generally the result of pressure by one blade of the forceps. There may be incomplete or complete paralysis of one side of the face. In the latter case, suckling is generally interfered with. The paralysis generally disappears within eight or ten weeks; but it has been known to remain permanent for life. This would probably mean complete division of the nerve.

Paralysis of a limb may result from injury to a nerve produced by traction upon an arm or leg, especially in association with fracture of the bone. It is generally more prolonged than facial paralysis, and is apt to be followed by some permanent impairment of power, sometimes by contraction.

Treatment.—In paralysis either of the face or a limb, gentle massage may be used after some weeks, if power does not quickly return. Later, electricity may be tried, especially in the case of a limb.

HÆMATOMA AND MYOSITIS OF THE STERNO-MASTOID. — This injury is relatively more common in pelvic presentations, but it occurs also in vertex presentations. In the former it is especially likely to be produced by traction upon the legs or body; in the latter it may be due to extraction by forceps. The lump is often not observed for some days after birth. It is at first soft, consisting of blood; later some inflammatory effusion occurs and the lump becomes harder, and may increase for a time. As a rule the lump entirely disappears in from four to eight weeks and leaves no permanent effect; but in some instances cicatricial contraction takes place, and torticollis is produced.

The other special injuries which may be produced by extraction in pelvic presentations have already been described (p. 604).

CHAPTER XXXVIII.

RETENTION OF THE PLACENTA AND POST-PARTUM HÆMORRHAGE.

Retention of the Placenta.

Causation.—Retention of the placenta may arise from inertia of the uterus, from morbid adhesion of the placenta or membranes to the uterine wall, or from the so-called hour-glass contraction of the uterus, a condition always associated with more or less inertia of the fundus. Any of these causes existing, retention is also promoted by unusually large size of the placenta, or by deviation of the uterine axis from that of the pelvis.

Inertia.—Normally the shrinking of the uterus on the expulsion of the fœtus separates the placenta partially, and perhaps sometimes wholly (see pp. 197, 198). If the uterus afterwards remains inactive, the placenta may be retained, notwithstanding that it is separated or almost entirely separated. The laxity of the uterus may be sufficient to cause post-partum hæmorrhage, or there may be sufficient tonic contraction to prevent excessive bleeding, but no rhythmical pain strong enough to expel the placenta and separate the remaining shreds of attachment. In general, when the placenta is long retained from inertia, the bleeding is greater than normal. The blood is then apt to collect behind the placenta and invert it in the manner shown in figure 97 (p. 200). When this occurs spontaneously, or when it is produced by traction on the funis, the difficulty of the expulsion of the placenta is increased. For the placenta, when in the form of an inverted umbrella, forms a larger mass to pass through the os than when folded longitudinally on itself in the natural manner as shown in figure 96 (p. 200). The degree of inertia necessary to cause retention is relative to the firmness of attachment of the placenta to the uterus. A slight excess of firmness at some remaining points of attachment, which would be broken down by a strong contraction, will suffice to cause retention if contraction is feeble. Inertia of the uterus is of course more likely to exist in the absence of the stimulation by external pressure and friction usually employed in the third stage of labour.

Adhesion of the placenta.—The separation of the placenta normally takes place through that layer of the decidua serotina which forms an open network of areolar spaces due to the dilatation of the uterine glands (see p. 56). Morbid adhesion occurs from failure in the development of this areolar layer, or its replacement by fibrous tissue, or from unusual firmness of the bands forming the trabeculæ. Any of these conditions is usually the result of previous endometritis, which may be syphilitic or not. The endometritis leads to excess of fibrous tissue in the decidua serotina, and this condition and the consequent adhesion of the placenta are apt to be repeated in successive pregnancies. With the morbid adhesion to the uterus may be associated fibroid or fatty or calcareous degeneration in the placenta itself (see pp. 354—356). It is hardly possible for the great shrinking of the placental site which accompanies the expulsion of the fœtus to occur without some separation of the placenta. Accordingly the adhesion is almost always found to be partial, the tracts of firmest attachment having alone resisted the effects of uterine shrinking. Hæmorrhage may occur from the placental site at the separated portion. Adhesion of the placenta is thus one of the causes of post-partum hæmorrhage, for the hæmorrhage is promoted by the presence of the placenta within the uterus preventing complete retraction and closure of the vessels. Its resistance to expulsion is also liable to set up irregular contraction, one part of the uterus remaining lax and allowing hæmorrhage while another is contracted.

Adhesion of the placenta sufficient to make artificial separation a necessity is a rare condition. It is apt to be inferred when it does not really exist, if the third stage of labour is badly managed, and the placenta is brought away piecemeal by the hand.

Adhesion of the chorion.—Retention of the placenta may also be produced by undue adhesion of the chorion to the uterine wall, especially when this exists around the edge of the placenta. The placenta is then specially apt to be inverted by blood effused behind it which does not escape externally. If the adhesion of the chorion is at a greater distance from the edge of the placenta, the placenta may be arrested when partially expelled into the vagina. Adhesion of the chorion is generally due to previous endometritis affecting that part of the uterus occupied by the decidua vera.

Diagnosis of adhesion.—There are no reliable signs during pregnancy of adhesion of the placenta. It may be expected as probable if it has been found more than once in previous deliveries. Sometimes there is during pregnancy pain referred to the fundus uteri, and produced by the inflammatory condition of the uterine wall. After delivery, adhesion may be suspected if good uterine contractions appear to occur without any descent of the placenta for a considerable time. In the very rare instance of complete adhesion there may be an absence even of the usual sanguineous discharge. This is rarely observed except in cases of abortion or premature labour, where the placental site is smaller and has therefore a better chance of resisting detachment through the uterine shrinking. More frequently there is a gush of blood with each pain, indicating a partial detachment of the placenta. If traction is made upon the funis with an adherent placenta, the whole uterus descends, the placenta not advancing, and pain is produced at the fundus. Such traction should however never be made. The only positive mode of diagnosis is to feel the adhesion when the hand is passed into the uterus for removal of the placenta.

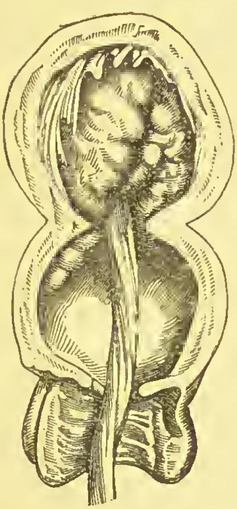

Fig. 266.—Hour-glass contraction of uterus, incarcerating placenta. (After Tyler Smith.)

Hour-glass contraction of the uterus.—The placenta may be retained in consequence of spasmodic contraction of the lower part of the body of the uterus associated with inertia of the upper part, especially of the placental site. There are two forms of such contraction. In the commoner, and that which most completely deserves the name of "hour-glass contraction," the part of the uterus spasmodically contracted is the internal os, the circular fibres around which form a sort of sphincter for the uterine cavity, and are the most ready to contract again after dilatation. The hand when introduced then feels a sharp ring of contraction. It is probable that many observers describing "hour-glass contraction" have not realised to what a height the internal os is raised, owing to the elongation of the cervix by stretching, and, accordingly, have supposed the constriction to be at a higher level in the body of the uterus. In other cases there really is a contraction of the part of the body of the uterus below the placenta, with atony of the placenta site, so that the placenta becomes encysted. This condition is apt to be reached if a more or less adherent placenta is allowed to remain for a considerable number of hours after delivery. There is generally not such a limited sharp ring of contraction, and the term "hour-glass contraction" is therefore not so fully suitable.

Causation of spasm.—The spasmodic contraction of the uterus is analogous to the spasmodic rigidity of the cervix in the first stage of labour, and like it is always associated with an absence of active expulsive pains. It may be a sequel of spasm during labour, and depend upon the same constitutional conditions. It may also be set up after delivery by irritation of the uterus produced by traction on the funis, by resistance of the placenta to expulsion owing to morbid adhesion, or it may be produced by the administration of ergot. In both spasm of the cervix in labour and in hour-glass contraction there is a disturbance of the natural nervous relations; and, in both, the so-called "polarity" of the uterus (see p. 148) has been said to be modified. If an active expulsive pain occurs, the circular fibres are not only distended by the advance of the placenta but undergo physiological relaxation. An atony of the placental site, with contraction of other parts of the uterus, similar to that which occurs in hour-glass contraction, may be the starting-point of inversion of the uterus. In cases of complete encystment of the placenta by contraction of the whole of the body of the uterus below its level, I have generally found that some morbid adhesion existed as a cause of the spasm.

Prophylaxis.—Retention of the placenta is best avoided by the judicious management of the third stage of labour, and is therefore apt to be much commoner in the practice of the inexperienced than in that of skilled accoucheurs. It is especially important not to make premature attempts to deliver the placenta, not to irritate the uterus by traction on the funis, and to use external pressure for expulsion only when the uterus hardens with a pain, repeating it, if necessary, with successive pains.

Treatment.—If there is no hæmorrhage of consequence, a fair trial should be given to the method of expression described in the chapter on the management of normal labour. If there is hæmorrhage the placenta should be removed at once. If the method of expression fails, the hand should be introduced for removal without any attempt to extract by pulling the funis. For this purpose the patient should be placed upon her back, and the hand passed up into the uterus, the fundus being supported by the other hand externally. If there is any constriction, it must be gradually dilated by the fingers in the form of a cone. If the placenta is found quite loose in the cavity, it has simply to be grasped and drawn down. If any attachment is found, it must be separated by passing the fingers side by side between the placenta and the uterine wall, the dorsal surface toward the uterus. Hence, if, as is usually the case, the placenta is found attached to the posterior wall, it is most convenient to begin detachment at the lower margin, the fingers being passed upwards and from side to side until the whole is separated. The placenta is then easily grasped by the hand and withdrawn. If the placenta is attached to the anterior wall, the hand must be passed up to the fundus first, and separate it from above downwards by the tips of the flexed fingers.

In the case of extensive and firm adhesion great care is necessary. The surface of separation will then probably be not in the decidua serotina but in the placental tissue itself. The main mass of placenta should first be separated in the way already described. Then the hand should be introduced again, and any separate pieces of placental tissue broken down by the pulp of the fingers, without the use of the nails, and removed. It is better to leave small shreds of roughness attached than to injure the uterine wall. After firm adhesion of the placenta, it is generally desirable to wash out the uterine cavity with antiseptics during the puerperal period.

If there has been previous hæmorrhage, the use of an anæsthetic should be avoided if possible. In any case ether is preferable to chloroform, as causing less complete and less prolonged relaxation of the uterus; and the anæsthesia should not be deeper than is necessary to allow the requisite manipulation. In the case, however, of a tight hour-glass contraction the effect of the anæsthetic in overcoming spasm may be essential, and chloroform may, in this instance, have the advantage.

POST-PARTUM HÆMORRHAGE.

Hæmorrhage after delivery may come from various sources. Hæmorrhage from the placental site is, however, so much the most frequent and most important, that this is regarded as post-partum hæmorrhage *par excellence.* The subject is one of immense importance, for post-partum hæmorrhage is not only one of the most dangerous complications, but is a relatively common complication of parturition. It may occur after the most perfectly normal labour, and a household may thus be unexpectedly plunged into grief by the sudden death of the patient. Nor is there any emergency in which so much depends upon the care and skill of the physician. The occurrence of hæmorrhage at all may generally be prevented by a careful and correct management of the third stage of labour. When hæmorrhage does occur, the life of the patient will generally depend upon the promptitude and vigour of the treatment.

Frequency.—The frequency of post-partum hæmorrhage varies so much, both according to the circumstances and social position of the patients and the skill of the accoucheur, that no estimate can be given. In the Guy's Hospital Charity (1863–1875) fatal cases were in the proportion of 1 in 2,040 deliveries, and formed about

10 per cent. of the total mortality after delivery. Deaths due to post-partum slightly exceeded in number those due to ante-partum hæmorrhage. The frequency of post-partum hæmorrhage in this Charity is probably much greater than the general average. For the patients are often very ill-nourished and frequently are late in sending for assistance, so that the child is often born before the attendant arrives.

Normal mechanism for controlling hæmorrhage.—The numerous large arteries and veins entering the placenta are torn across on separation of the placenta through the shrinking of the uterus, and the blood which follows the birth of the child comes from these vessels. The arrest of bleeding depends upon the compression of the vessels by the contraction of the uterus. This is facilitated by the anatomical arrangements already described (see p. 105), namely, the spiral course of the arteries and the so-called "falciform valves" in the venous sinuses. The veins, however, are destitute of true valves, and thus, in the absence of contraction, blood may pour in great volume from the veins as well as from large arteries. Fatal hæmorrhage may thus occur in a few minutes.

Besides the contraction of the uterus, a part of importance is also played by retraction, that is to say, by the reduction of its size and thickening of its walls, not followed by relaxation and expansion. The more complete is the retraction the more thoroughly are the vessels closed and blood squeezed out of the large venous sinuses. Hence the security against hæmorrhage is greater after the delivery of the placenta than before.

After delivery, as at other times, uterine contractions only take place rhythmically at intervals. It is only during a contraction that the well-known hard, defined, cricket-ball-like outline of the uterus is felt which assures the physician of the impossibility of hæmorrhage from the placental site for the time being. But, even during the intervals, although the uterus becomes softer, a sufficient amount of tonic contraction normally remains to prevent the vessels becoming patent again. The uterus should not become larger during the intervals of contraction. A further security against hæmorrhage is afforded by the thrombi which form in the vessels, but it is unknown how soon these are normally produced. Owing to the presence of these, even a morbid relaxation of the uterus at a considerable interval after the delivery of the child is not necessarily accompanied by hæmorrhage.

Causation of hæmorrhage.—The one essential cause of hæmorrhage from the placental site is atony of the uterus, and without this it can never occur. The atony does not necessarily affect the whole uterus, but hæmorrhage may occur with irregular contraction, some part of the uterus being contracted and some relaxed. In this case it is essential that the placental site, or part of it, should be the atonic portion, as it is generally apt to be. If the whole uterus is relaxed it may allow itself to be dilated again to a considerable size by the blood poured out into it. Given a certain amount of uterine atony, there are other causes which promote hæmorrhage. The first of these is imperfect uterine retraction. This may be due to the placenta being still within the uterus, especially when partially adherent, to the presence of clots within it, distending its cavity, or to a fibroid tumour in its walls, which prevents due retraction. Other causes promoting hæmorrhage are excessive vascular tension, arterial or venous, excited action of the heart, relaxation of the arteries supplying the uterus, and any condition of the blood rendering it less prone to form thrombi. In those women who show a special proneness to flooding in successive deliveries it is probable that some of these causes are often in operation, as well as a tendency to uterine inertia. Too early assuming the erect posture may also promote hæmorrhage, by increasing the statical pressure in the vessels and exciting the circulation.

Causation of uterine atony.—The constitutional causes of uterine atony after delivery are similar to those which produce inertia in labour, and hence, when there has been marked inertia in labour, the physician should be on his guard against post-partum hæmorrhage. Any debilitated condition or any form of malnutrition may be a cause of inertia. Certain women have a constitutional proclivity to flooding, not easily explained, and have been described as "flooders." This proclivity may depend upon some morbid state of the nervous system, since the uterine contraction is directly regulated by the nerves. A diseased state of the "ganglion cervicale uteri" has been assigned as one possible cause.* To these constitutional causes must be added exhaustion from protracted labour, previous over-distension of the uterus, as from twins or excessive liquor amnii, and the administration of chloroform. Too rapid artificial delivery while the uterus is quiescent may also be a cause. Spontaneous precipitate labour is also described as likely to be followed by hæmorrhage, but this tendency appears to have been exaggerated. In a large proportion of cases the relaxation of the uterus which allows the hæmorrhage occurs when for some reason the physician has omitted to keep a constant watch on the condition of the uterus by keeping his hand upon it continuously until the placenta has been delivered, and he is assured that a satisfactory and permanent uterine contraction has been obtained. Some of the worst

* Jastreboff in Obst. Trans., Vol. XXIII.

cases have happened when attention has been diverted by the necessity for resuscitating the child, or when the child has been born before the arrival of the physician.

Symptoms and Diagnosis.—The hæmorrhage may occur immediately after the birth of the child, or, after remaining contracted at first, the uterus may relax again and allow hæmorrhage either before or after the delivery of the placenta. At first the blood is poured out into the flaccid uterus. After a while a contraction may occur and expel it in a copious stream; or the same effect may be produced by the patient's coughing or bearing down, or the pressure of the hand upon the fundus. The quantity may be so great as to drench the bed, and even pour abundantly on to the floor. Even without external flow the uterus may allow itself to be expanded again so much that dangerous and even fatal hæmorrhage may take place into its interior. The physician can only be certain that no excess of hæmorrhage is going on by keeping his hand for a sufficient time upon the uterus, making sure that it does not altogether lose its definite outline or become enlarged in the interval of contractions, and that no copious gush of blood from the vagina is produced by a pain or by pressure upon the fundus. If hæmorrhage occurs without even temporary relaxation of the uterus, it must be due to some other source of bleeding, such as laceration of uterus, cervix, vagina, or vulva, and careful search must be made for the source. It has even been known that a patient has bled to death from a ruptured varicose vein in the leg, while the accoucheur was directing his attention to the uterus.

A copious hæmorrhage may be quickly followed by syncope, which is in some cases an advantage, since it checks the flow of arterial blood. Otherwise, in severe cases, the pulse becomes rapid and weak, or even imperceptible; there is extreme pallor of the face, lips and gums, the patient is bathed in cold sweat, she gasps for breath, for lack of sufficient blood corpuscles to carry on respiration properly, and tosses her limbs about restlessly. Towards the last she complains of being unable to see. Voice and even muscular strength may apparently remain good almost to the end. The gravest signs of impending death are absolute failure of pulse, extreme restlessness, and failure of sight.

Prophylaxis.—In the great majority of cases, hæmorrhage may be averted by due care, although, very exceptionally, women are found in whom flooding takes place notwithstanding the utmost precautions. But practitioners who manage labour properly will never find post-partum hæmorrhage anything but a rare occurrence.

If women are known to be liable to flooding they should be treated if possible during pregnancy by tonics, especially iron, or iron and quinine, as well as by good diet and other hygienic means. In such women, a dose of ergot may be given just as the head is reaching the perineum, if it is certain that no obstruction exists. The same treatment may also be adopted in multiparæ, when inertia of the uterus has been very marked throughout labour. Chloroform should be avoided, as far as possible, in the case of women prone to hæmorrhage. When chloroform is given to the full degree, as for obstetric operations, anæsthesia should not be deep at the final stage of delivery, and the uterus should not be emptied too quickly, but allowed to expel (in head presentations) the body of the child. The most important part of all in the prophylaxis of hæmorrhage is that the physician should manage the third stage of labour correctly according to the principles already described, following down the fundus uteri with his hand at the expulsion of the child, and keeping a watch upon the uterus until the placenta is expelled, and permanent contraction is secured. While engaged in tying the funis, or resuscitating an asphyxiated fœtus, he should direct the nurse or other assistant to keep up pressure upon the fundus.

Ergot is useful rather as a prophylactic, or to prevent recurrence, than in the presence of severe hæmorrhage, for there is then no time for it to act. If it is found difficult, after removal of the placenta, to maintain a sufficiently firm condition of the uterus, or if gushes of blood take place whenever the uterus hardens, ergot should be given. The most rapid method is to inject two grains or more of ergotin deeply into the gluteal muscles. For this purpose, Savory and Moore's gelatine discs, or the solution of ergotin prepared by Huggett of Liverpool, are convenient forms. In the absence of ergotin, a drachm dose of the liquid extract of ergot may be given, and repeated, if necessary, or a fresh infusion may be made of sixty grains of powdered ergot, and the powder and infusion administered together. The liquid extract, diluted with an equal part of water, may also be used hypodermically. A wineglassful of vinegar, taken by the mouth, has sometimes been found to check hæmorrhage rapidly. It may probably cause a reflex effect upon the uterus. In any case in which flooding is anticipated, a hypodermic syringe should be ready, filled with a solution of ergotin, and iodoform gauze for plugging the uterus or solution of perchloride of iron should also be prepared. In all cases hot water should be at hand.

It has been observed that a probability of hæmorrhage is indicated if the pulse remains rapid after delivery, instead of falling to a quiet rate. Whenever this condition is observed, therefore, the condition of the uterus should be watched for a longer time than usual, and a dose of ergot may be given with advantage.

Treatment.—The essential point in treatment is to secure contraction of the uterus, and by far the greater part of the value of all the means used for the arrest of hæmorrhage consists in their efficacy in producing this effect. The first expedient to be tried is that of direct manual stimulation to the uterus. The patient should be placed on her back, and the uterus grasped, compressed, and kneaded with both hands. Care must be taken not to cause inversion of the relaxed uterus by pressing downward one part of the fundus. If this treatment does not quickly succeed in producing hardening and contraction, one hand should be introduced into the uterus, all clots turned out, and the placenta removed, if it has not previously been expelled. The uterine walls are then compressed between the outside hand, and that in the uterine cavity, the latter affording an additional stimulus to contraction. If the placenta has been expelled, the uterine walls should be examined, while in a state ofcontraction, to make sure that no portion of placenta or membranes remains attached. When this has been done, and fair contraction secured, the hand should be slowly withdrawn into the vagina, and the fingers placed in the posterior cul-de-sac, so that the cervix is received in the hollow of the hand. The fundus is then drawn forward toward the pubes in the grasp of the external hand, and the uterus compressed in the direction of its axis until retraction is secured, and the cavity closed.

If bimanual compression does not produce adequate contraction, or if relaxation and hæmorrhage recur, stimulation by cold or heat should be tried. Both cold and heat stimulate the uterus to contract; but, of late, the use of cold has been, to a great extent, superseded by the injection of hot water. Cold, however, may be used for slight cases, and as a first measure, since it can be applied more quickly. The patient should not be drenched with cold water; but a towel dipped in cold water may be suddenly applied to the buttocks or abdomen; or, if ice is at hand, a piece of ice may be applied in the same way.

Intra-uterine injection of hot water has been found a valuable means of exciting uterine contraction, and has apparently, in many cases, averted the necessity for the injection of a solution of iron. A large basinful of water should be ready, and the temperature should be from 110° to 115° F., or the water may be used as hot as the hand can bear. The patient's hips may be brought over the edge of the bed in the lateral position, and a mackintosh arranged to convey the water to a footpan below. A long tube should be used which can be passed up to the fundus uteri, and has a curve corresponding to that of the genital canal, either a metal tube such as Hayes' (Fig. 267, p. 763), or one of vulcanite or glass. The metal tube has the advantage that the perforations at the end can be made smaller and more numerous, the vulcanite or glass tube that it is not corroded if used for injections of mercury or iodine. In the absence of a special tube, the ordinary Higginson's syringe can be used, but it will be necessary to pass the vaginal tube wholly into the uterus. The water is then to be injected in considerable quantity, several quarts at least, until contraction is produced, care being taken to avoid the injection of air.

A new treatment has been introduced for those extreme cases of post-partum hæmorrhage in which all ordinary means fail to excite uterine contraction, and in which the only available treatment has hitherto been the use of perchloride of iron or other styptic, namely, plugging the uterus. At first sight, this appears to be at variance with the principle that the only security against hæmorrhage is retraction of the uterus, and that distension of that organ promotes further bleeding. The explanation of its success is that the contact of a rough material with its interior is a very powerful stimulus to uterine contraction, and that the uterus therefore does not allow itself to be greatly distended.

The safest material to use is iodoform gauze in long and rather broad strips. In the absence of this, muslin, lint, or any available material may be used, and should be sterilised by boiling water, if time allows. It should be dusted over with iodoform. If several strips are used, a tape should be tied to each, to facilitate withdrawal. The plug should be carried completely up to the fundus, and as much introduced as can be packed into the uterus, clots having first been cleared out. It must always be remembered that plugging the vagina is absolutely disastrous in post-partum hæmorrhage, and that it would be equally bad practice to plug only the lower part of the uterus, leaving the top of the fundus unfilled. The plug may be left in situ twenty-four hours. On its removal, the uterus should be irrigated with perchloride of mercury, 1 in 2000.

Dührssen* records 65 cases of post-partum hæmorrhage treated by the uterine plug, with 6 deaths, of which one only was from septicæmia. It appears probable that, in skilled hands, this treatment may prove less dangerous than the injection of perchloride of iron, but there is as yet little evidence on the subject in Britain. The proportion of deaths in cases so treated affords little guide, because different observers may estimate differently the severity of hæmorrhage which requires extreme measures. The best proof of the efficacy of the new treatment would be the diminution by its means of the proportion of deaths from post-partum hæmorrhage to deliveries on a very large scale, as in the statistics of the large maternity charities.

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* Sammlung klinische Vorträge. 1890.

The alternative to plugging the uterus in extreme cases of hæmorrhage is the injection of perchloride of iron, or other styptic. It has been claimed for this that it arrests hæmorrhage by producing thrombosis in the mouths of the vessels, but it is probable that its main action is that it is a still more powerful stimulus than all ordinary means to uterine contraction. There are three serious risks in the injection of perchloride of iron, and it should not therefore be used unless all ordinary means have been tried in vain, and the patient is in imminent danger of death. First, a coagulum may be carried from a uterine sinus, and cause pulmonary embolism. Sudden death from this cause has occasionally followed the injection. Secondly, the solution may pass along the Fallopian tubes, and set up peritonitis. This appears less likely to occur in the puerperal than in a non-puerperal uterus, in which the Fallopian tubes are more likely to be patulous from disease. Thirdly, the clots formed by the iron solution in the uterus, as well as the thrombi in the vessels, are apt to decompose and set up septicæmia.

It is better to use a moderately strong solution than a weak one, since it is more likely to cause uterine contraction, and not penetrate so far into the vessels. One part of the liquor ferri perchloridi fortior to three or four of water may be used, or the solid perchloride of iron may be dissolved in about eight parts of water. This forms a less irritating solution, but takes longer to prepare. Monsell's solution,* the liquor ferri subsulphatis of the United States Pharmacopœia, is also a very powerful styptic with little irritating effect. This may be diluted with three or four parts of water.

The uterus should first be cleared as much as possible from blood and clots. Then a few syringefuls of water may first be introduced, to wash out the remaining blood. Next the end of the Higginson's syringe is transferred to the vessel containing the iron solution, and the injection of that immediately proceeded with. If the hæmorrhage stops, there should be no further compression or manipulation of the uterus, lest the thrombi formed should be displaced from the vessels.

For the intra-uterine injection, either of water or iron solution, it is best to use a long vulcanite or metal tube, having its end pierced by small holes, as in the case of the injection of hot water. After the injection of the iron solution, the uterus should be washed out daily with an antiseptic solution through the puerperal period, in order to prevent decomposition of the clots, or get rid of them as soon as possible.

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* This is prepared in a similar way to the liquor ferri persulphatis of the British Pharmacopœia, but the ingredients are so proportioned that the result is a basic ferric oxysulphate. The proportions are: sulphate of iron, 5,760 grains; sulphuric acid, 510 grains; nitric acid, 780 grains. Water is added to make up 12 fluid ounces.

The danger attending the use of the iron injections has been variously estimated by different authorities. In 23,951 deliveries in the Guy's Hospital Charity it was used 12 times. In all instances it stopped the bleeding; but in 5 it did not prevent death from hæmorrhage. One patient died from septicæmia on the 26th day. The remaining 6 recovered; but in 3 of them transient febrile symptoms occurred on the second or third day. It did not appear that the injection precipitated death in any case.

It is recommended by some authorities not to inject the iron solution, but to introduce it into the uterus by means of a sponge or other form of swab, which is either withdrawn after being squeezed, or left in the uterus until it is expelled. Others again have introduced a uterine plug soaked in the iron solution.

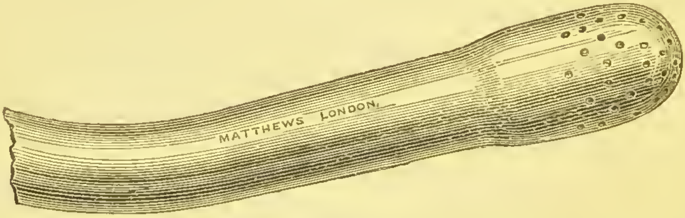

Fig. 267.—Hayes' silver tube for injecting uterus.

The method of injection, however, appears to afford the surest means of distributing the styptic over the whole of the bleeding surface.

Other liquids have been used for introduction into the uterus, either by means of swabs or by injection, in order to act as powerful stimulants to contraction by their contact with the internal surface, not by producing coagula. Among these are tincture of iodine and vinegar. They do not arrest the bleeding with so much certainty as the iron solution, but vinegar has the advantage that it is generally procurable in any house, if the iron salt is not at hand.

Treatment of resulting anæmia.—In slight cases of hæmorrhage it is sufficient to give liquid nourishment as soon as possible. Beef-tea or fluid meat, with plenty of salt, answers well, since it allows water and saline constituents to be absorbed quickly and replenish the volume of the blood. It is well also to give a dose of opium or subcutaneous injection of morphia, in order to quiet the circulation, and relieve the nervous irritability which results from hæmorrhage.

In graver cases, in which there is temporary syncope, failure of pulse, extreme pallor, vomiting, or great restlessness, the chief indication is to maintain the action of the heart and avert fatal syncope. In the great majority of cases of post-partum hæmorrhage the patients recover if they do not die from syncope within an hour or two. Sometimes, however, it appears that not enough blood-corpuscles are left to permanently carry on respiration or maintain the nutrition of the heart. Then, although the pulse may improve for a time, it fails again, and the patient dies sometimes after a considerable number of hours. This result is more likely if there has been ante-partum hæmorrhage, for then the loss is generally more gradual, and a patient may be more completely drained of blood without the immediate production of fatal syncope.

The first point is to counteract anæmia of the brain by depressing the head. All pillows should be taken away, and the head should not be raised at all for any purpose, such as the giving of nourishment, till it is certain that all danger has passed away. It is useful also to raise the foot of the bed upon blocks, so that the head may be lower than the body. Alcohol should be avoided until the hæmorrhage is arrested. When that is done, brandy may be given if the patient is not sick. If she is sick, or if brandy does not suffice to revive the pulse, subcutaneous injections of ether should be given. Twenty minims may be used at a time, and the injections repeated as required. In the absence of ether, brandy may also be injected subcutaneously.

Auto-transfusion.—If the pulse still indicates danger, notwithstanding the use of stimulants, there is a valuable resource in a method which has been called auto-transfusion. This consists in bandaging the limbs, so as to save a larger proportion of the blood to fill the heart and vessels of the brain. The legs should be bandaged from the feet to the hips. Esmarch's elastic bandage is the most effective, but, in its absence, a calico bandage, firmly applied, may be used. The arms may also be bandaged in the same way. The bandages may be allowed to remain for some hours, until the patient has been able to retain nourishment and the pulse has revived.

Transfusion of blood.—When all other means fail, life may sometimes be saved by transfusion of blood. This operation, however, when performed by any of the methods which have usually been adopted, involves a risk of killing the patient through embolism of the pulmonary artery instead of curing her. Patients sometimes recover, even without transfusion, when their case has appeared almost hopeless. Hence it is always difficult to be sure, in cases of transfusion recorded as successful, whether the operation has really saved the life of the patient. It is probable that, in some instances, it has rather increased than diminished her danger. In others, again, there is reason to believe that it has actually accelerated death.

The most perfect method of transfusion theoretically is that recommended by Prof. Schäfer,* as the result of the investigation of the subject made by him in 1879 on behalf of the Obstetrical Society of London. Prof. Schäfer recommends arterial transfusion from the dorsalis pedis artery of the donor into that of the receiver. The arteries of each are first to be exposed and separated from the sheath for about three-quarters of an inch. The distal ends of the exposed portions of artery in both are then to be tied, ligatures are to be placed loosely round the upper ends also, and these upper ends are to be secured by spring clips. The transfusion apparatus itself consists simply of an india-rubber tube having a glass cannula at each end. Each cannula has a tapering bevelled extremity, with a groove near the end to hold the ligature. Both arteries are to be divided below the spring clips, and one cannula is to be tied into the artery of the donor, the other into that of the receiver, the ends of both being directed towards the heart. The clips are then to be opened for about a minute, or a little longer if it seems desirable, the effect on the pulse of the donor and receiver being watched meanwhile. Both arteries are then to be tied just above the clips, and finally the cannulæ are to be cut out and removed, together with the pieces of artery into which they are tied.

The advantages of arterial transfusion performed after this method are the following :—The blood transfused is oxygenated ; the flow through the tube being rapid, under arterial pressure, clotting is not so likely as in transfusion from vein to vein ; if any clots are formed, they produce embolism only of peripheral vessels and do not kill the patient ; and the arterial tension of the receiver is more immediately raised than if the blood had first to make its way from a vein. The tendency to syncope is therefore more quickly averted.

The great drawback to the operation is that it is a somewhat serious one for the donor as well as the receiver, and that, since it is performed on the foot, it requires him to be kept quiet in bed afterwards. Circumstances often will not allow this. Also in a restless and pulseless patient, not under the influence of an anæsthetic, the dorsalis pedis artery might be even more difficult to dissect out than a superficial vein.

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* Obstet. Trans., Vol. XXI.

As the next best method, Prof. Schäfer recommends direct transfusion from vein to vein through a simple elastic tube. The tube and glass cannulæ are the same as in the former case. Both veins are to be exposed, the cannula is to be tied into the vein of the donor, but only held in that of the receiver. Blood is to be allowed to flow for about three minutes, or until the condition of the donor or that of the receiver shows that sufficient has been transfused.

I have used of late the apparatus shown in Fig. 268, p. 768, which is a modification of that suggested by Prof. Schäfer for venous transfusion. The cannulæ, instead of being glass cannulæ which have to be tied into the veins, are tapering silver cannulæ, like those of Aveling's apparatus. The receiving cannula is shown at C, Fig. 268; the delivery cannula at D. The former has a round opening at the end, not liable to be closed by the wall of the vein falling against it. The bevelled extremity of the delivery cannula, D, is easier to slip into the empty vein of the patient. The terminals, A, B, fit into the cannulæ. They are perfectly smooth inside, and the ends are made as thin as possible, so that, when they are fitted into the cannulæ, there is scarcely any projecting rim within the lumen of the tube, either on the side of the elastic tube or on that of the cannula. The outside of the terminal is grooved, so that it is readily held by the finger and thumb to insert it into the cannula. The india-rubber tube should not be more than five or six inches long, so that the chance of clotting may be diminished as much as possible. This arrangement has certain advantages compared with more elaborate instruments, the india-rubber of which is apt to be found cracked and useless when required for use after an interval. In this apparatus, the tube can be renewed from time to time without appreciable cost, or, if necessary, it can always be replaced with a piece of ordinary drainage tube. The whole apparatus occupies scarcely any room, and may without inconvenience be carried constantly in the obstetric bag.

Besides the transfusion apparatus, the following instruments are required;—a sharp scalpel, fine dissecting forceps, a pair of sharp-pointed scissors, two probes or aneurism needles, a small director for guiding the cannula into the vein, if necessary, and sponges. Two assistants are required, one to keep the patient's arm steady, one to hold the cannula in the donor's arm.

Operation.—The mode of procedure should be as follows:—Place the tube, with the cannula attached, in a hot solution of common salt or carbonate of soda (gr. lx. ad Oj.). When the tube is full, and all air removed from it, place a spring clip on it at each end close to the terminal. Take the left arm of the donor and the right arm of the patient, and choose the vein in each which is most prominent. Generally the median basilic will answer the purpose. Tie tapes round the arm of the patient, first above and then below the vein to be opened. Make a transverse incision over the vein, and prepare the vein by exposing a portion of it, and passing an aneurism needle or probe underneath it. When the veins are empty, especially if there is much superficial fat, finding this vein is the most difficult part of the operation. Then tie a tape round the arm of the donor, above the vein which is to be opened. Expose the vein in the same way as that of the patient, and pass a probe underneath it. Now let the donor sit by the bedside, and place his arm close to that of the patient, the fingers pointing in the same direction. Take the delivery cannula, D, out of the saline solution, open the patient's vein by an oblique snip with sharp-pointed scissors, and see that the cannula slips readily into it toward the proximal side of the opening. Replace the cannula in the saline solution, and remove the tape above the opening in the vein. Now take the transfusion tube with both cannulæ attached, open the donor's vein with an oblique snip with scissors, and slip the receiving cannula, C, into it, toward the distal side of the opening, passing it gently on so far that by its conical shape it fills the vein, or the opening in the vein, and does not allow blood to escape by the side. Let an assistant hold the

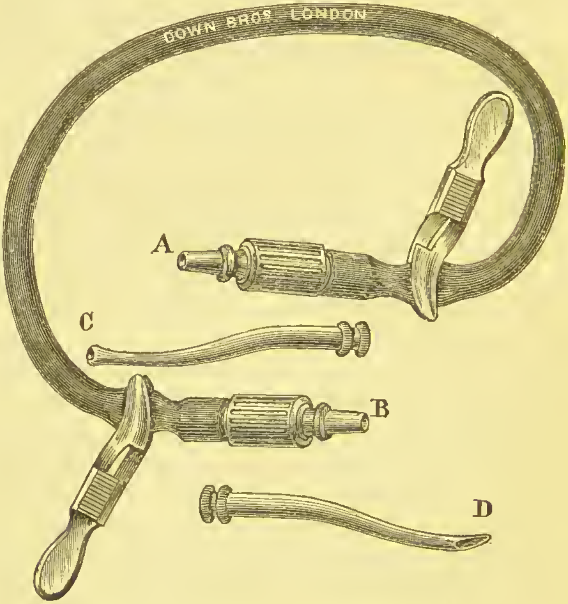

Fig. 268.—The Author's transfusion apparatus.

cannula in place, and remove the spring clips from the tube, keeping the delivery cannula slightly raised above the donor's vein, so that any remnant of air in the tube may be expelled. As soon as blood begins to flow from the delivery cannula, slip the cannula into the receiver's vein and hold it there, having passed it in far enough to prevent escape of blood by the side as in the case of the receiving cannula. The flow will be aided if the patient's arm is raised slightly above the level of the shoulder.

With this method the quantity of blood transferred cannot be measured. We must judge when to conclude the operation partly by the effect on the pulses of donor and patient, and partly by time. I have found about five or six minutes' flow to be sufficient. The cannulæ are then withdrawn, the tapes removed from the arms, and each vein is closed by a pad and bandage as after venesection. With this apparatus, as with others, a clot is liable to be formed in the tube, after the flow has proceeded for some minutes. But it remains in the tube and is not carried into the patient's circulation to produce pulmonary embolism, as it is when any form of pump is used. The effect is only to arrest the flow. If it is desired to ascertain if the flow is still going on, this may be done by separating for a moment the terminal from the delivery cannula (D).

Transfusion from vein to vein has hitherto generally been performed by an apparatus in which the operator accelerates the flow of blood by squeezing a bulb, as in Aveling's and Roussel's instruments. Although successful transfusions have been performed with these, there is always a risk that clots may be pumped into the circulation, and cause pulmonary embolism.

Mediate transfusion of blood.—The plan of using defibrinated blood for transfusion is a tempting one on account of its facility. It has the advantages that the operation for the donor is that of simple venesection; that the blood may be prepared in another room, so that, if the donor is the husband, his nerves may not be shaken by the sight of his dying wife; and that there is no need for any hurry or rapidity of procedure. The disadvantages, however, more than counterbalance these. They are that the white corpuscles at any rate are more or less disintegrated; that, even after defibrination for five minutes, other small clots are liable to be formed and to produce embolism; that the same result may be caused through clots produced in the patient's blood by the liberated fibrin-ferment; and, finally, that septic germs may be introduced with the blood. If, however, there is imminent prospect of the patient dying, and if the only donor to be obtained is too agitated and unsteady to go through the operation of direct transfusion, mediate transfusion may give a chance of saving the patient.

The simplest and best apparatus to use is the delivery cannula (D) and terminal (B) of the same transfusion apparatus (Fig. 268, p. 767) connected by a piece of india-rubber tube about three feet long with a large glass funnel. The procedure should be as follows:—The funnel and tube are immersed in saline solution, so as to expel all air from the tube, and a spring clip is placed at the lower end of the tube close to the terminal. The patient's vein is exposed and prepared as before. The donor is then bled to about twelve or fourteen ounces. The blood is received in a bowl, and stirred gently with a clean fork for about five minutes. It is then filtered through a piece of muslin, first moistened with the saline solution, into a jug, which is placed in a basin of warm water. The tube is now held with the funnel uppermost, and the blood poured into the funnel. The spring-clip is opened until blood begins to appear at the cannula, then closed again. Next the patient's vein is opened, the cannula slipped into it, and the spring-clip removed. As the blood falls in the funnel, it must be kept replenished from the jug, till all has been injected. The flow is accelerated by raising the funnel. To prevent the injection of small clots formed after defibrination, it is a good plan to place a small piece of muslin in the funnel, so as to filter the blood again at the last moment.

Intra-venous injection of saline fluid.—The plan of injecting a saline solution into the veins is certainly inferior in efficacy to transfusion of blood. It is however free from the risk which attends the other operation. Such injections tend to counteract the tendency to fatal syncope resulting from emptiness of the vessels, but not the failure of respiration or of the nutrition of the heart from lack of blood. They are probably useless when the patient fails again after being at first revived by stimulants, and after being able to absorb fluid from the stomach. Even when used at the early stage they have, in some cases, proved to be of temporary benefit only. Of late, these intra-venous injections have been much practised for the hæmorrhage and collapse of ordinary surgical operations, and have been found to have a powerful effect in improving the pulse and rallying the patient from the collapsed condition. The modern plan is to inject in all cases a considerable quantity of the fluid, as much as from four to six pints. The saline used may be common salt, or two parts of salt mixed with one part of bicarbonate of soda. About 90 grains of the mixture may be dissolved in each pint of hot water, which should have been sterilised by boiling, if time allows. The solution should be strained through muslin or filtered, and injected at a temperature of about 100° F. The funnel with tube and cannula is the best apparatus to use, or a large glass syringe, with the piston removed, answers very well the purpose of a funnel.

In Figure 269 is shown the mode of using an apparatus devised by Dr. Horrocks for intra-venous injection of fluid. In this case, the cannula has a small round, not a bevelled opening; and has to be tied into the vein.

An equally good effect has been claimed for the plan of injecting a saline fluid into the cellular tissue. A special apparatus has been invented for this, but one can be improvised with a piece of drainage tube four or five feet long, a large funnel, and an aspirator needle. The funnel is fixed at one end of the tube, and the needle at the other. The tube having first been filled, the needle is inserted into the gluteal region, the fluid is allowed to flow by gravity, the funnel being kept filled, and is disseminated in the cellular tissue by massage.

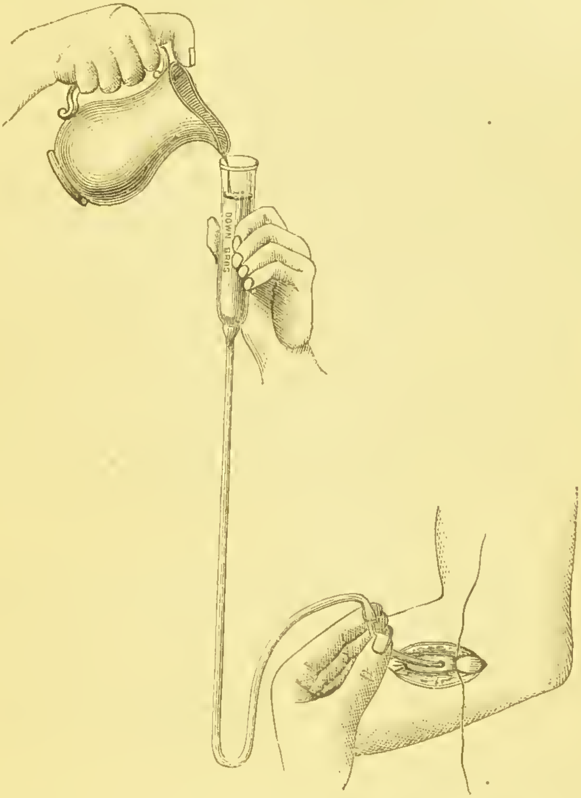

Fig. 269.—Horrocks' apparatus for intra-venous injection.

After-Treatment.—After transfusion, or in cases of hæmorrhage of severity just short of that demanding transfusion, great care is necessary in giving fluid nourishment frequently and in very small quantities, in order to secure, if possible, its retention and absorption. At first, not more than a table-spoonful should be given at a time. Fluid meat or beef-tea may be given at first, milk or gruel a little later, brandy being added if the pulse flags. The head must be kept low until all danger of syncope has passed.

Secondary puerperal hæmorrhage.—Secondary puerperal hæmorrhage may occur at any time within the puerperal period, sometimes even several weeks after delivery. The bleeding may be caused by detachment of thrombi from the vessels at the placental site, or the blood may come from other parts of the mucous membrane. The hæmorrhage may take the form of excessive lochial discharge, or a profuse loss may come on unexpectedly.

Causation.—Hæmorrhage may arise from any cause producing active or passive congestion of the uterus. Among these are over-exertion, getting up too early, mental excitement, inversion of the uterus, laceration and inflammation of the cervix, retroflexion of the uterus, retention of clots within the uterus, sometimes merely a relaxed condition of uterus, or softened congested state of the mucous membrane. The most important cause of all is the retention of a piece of adherent placenta or membranes. This cause should be suspected as probable if, after a normal lochial discharge at first, a profuse loss comes on after ten or fourteen days. Constitutional conditions, such as albuminuria, may also predispose to secondary hæmorrhage.

Treatment.—A vaginal examination should always be made, and if the cervix still admits the finger, and the loss is considerable, the uterine cavity should be explored. If the cervix is found closed, and the loss not excessive, the patient should be kept perfectly at rest, and styptics, such as the liquid extract of ergot in half drachm or drachm doses, or tincture of cannabis indica in fifteen minim doses, should be administered. Any retroflexion of the uterus should be rectified by a pessary.

If this treatment fails to arrest the loss, or if the bleeding is excessive, the interior of the uterus should be explored, the cervix being first dilated by Hegar's dilators or a tent if necessary. If involution has proceeded to a considerable extent, it will be possible to reach the fundus without introducing more than the index finger into the vagina, as in the case of an abortion (see pp. 410—414). If the uterus is still large, it will be necessary to pass the half hand or whole hand into the vagina. For this purpose, an anæsthetic must be administered, if necessary. If any placenta or membrane is found within, it must be carefully broken down by the finger and removed. This will generally suffice to arrest the hæmorrhage. If only a softened, congested state of mucous membrane is found, the uterine cavity may be swabbed with a strong tincture of iodine, introduced up to the fundus by means of a Playfair's probe or uterine sound wrapped with absorbent cotton. If this application still fails to arrest bleeding, a solution of perchloride of iron may be used as in the case of primary post-partum hæmorrhage (see p. 763). In most cases application of the iron solution by a swab of cotton will be sufficient; but, if necessary, it may be injected into the uterus. If the plan of injection is adopted, a Budin's double-action catheter (Fig. 153, p. 416), or, in the absence of this, a large gum-elastic catheter may be attached to a syringe by an india-rubber tube, and the catheter passed into the uterus. If, however, the cervix is still wide, the vulcanite or metal tube may be used, as in primary post-partum hæmorrhage. It is essential that the cervix should be wide enough to allow free escape of the solution. A still safer plan is to inject only by hydrostatic pressure, by means of a funnel, and an elastic tube four feet long, attached to the catheter. In either case, care should be taken to fill the tube, so far as possible, with the fluid, and to avoid the injection of air.

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CHAPTER XXXIX.

PUERPERAL FEVERS.

THE nature of the disease known as puerperal fever has been the subject of much controversy. The view that it is a specific zymotic disease, analogous to small-pox or scarlatina, but liable only to affect puerperal women, has been generally abandoned. The modern view is that the affections which have been included under the title of puerperal fever or metria are analogous to the febrile disturbances which may follow surgical wounds, and are due to absorption at some surface, either that of the placental separation, or at lacerations of the cervix, vagina, perineum, or vulva.

That puerperal fever, in its severe forms, is a highly contagious disease there can be no doubt. This is proved both by the records of lying-in hospitals and by those of private practice. In consequence of this disease the death-rate of some lying-in hospitals has, over a considerable interval, been as high as 15, 20, or even 30 per cent. In many instances such hospitals have had to be closed in consequence of its prevalence, and in some, when the closing has been too long deferred, almost every puerperal patient has died. On the other hand, recent experience in lying-in hospitals has shown that, with careful use of modern antiseptic precautions against the possibility of contagion being conveyed, mortality may be as low, or lower, in lying-in hospitals than in private practice. The contagious character of puerperal fever is equally proved in private practice by the unfortunate instances in which a single case of the disease is followed by a series of severe or fatal cases among the patients attended by the same person, a series arrested only by his entirely giving up midwifery practice for some time.

The chief arguments showing that puerperal fever is not a specific zymotic disease are the following:—(1) the symptoms and anatomical lesions of the disease have not a special and definite character like those of a specific zymotic disease, but are rather analogous to those of septicæmia or pyæmia following surgical wounds. The micro-organisms found are also the same as in surgical septicæmia and pyæmia. (2) A definite local cause, such as the decomposition of retained placenta, may give rise to a disease indistinguishable from puerperal fever due to conveyed contagion, and having the same anatomatical lesions. (3) A similar condition following abortion in the earlier months gives rise to a febrile disturbance which resembles puerperal fever, though it generally differs from it in being less fatal. (4) Puerperal fever may be originated not merely by contagion conveyed from other puerperal women, but by various kinds of septic material, notably by post-mortem poison. This was specially demonstrated by Semelweiss, who showed that among the patients in the lying-in hospital at Vienna attended by students who at the same time were attending the dissecting and post-mortem rooms the mortality was as much as 10 per cent. Among those attended by women in the same institution it was only 3 per cent. In consequence of this evidence, strict rules were enforced that the students should wash their hands with disinfectants and not merely with soap and water, and a great reduction of mortality was thereby obtained.

Organisms in puerperal fever.—Many other contagious diseases having been proved or suspected to be due to the multiplication in the blood or tissues of living organisms, it might be expected that the same would be found to be true of the contagious forms of puerperal fever. There is evidence that this is actually the case. The ordinary bacteria which are the chief agents in the putrefaction of organic fluids do not live and multiply in the tissues. They are usually present in the lochial discharge, and doubtless tend to cause suppuration of the lacerations in the genital canal, which would heal by first intention, and without inflammation, if they could be kept perfectly aseptic. If the discharge or if clots are retained after decomposition, the poisonous material produced by the bacteria of decomposition is liable to be absorbed, and to produce poisonous effects, although bacteria of this kind do not themselves multiply in living tissues. The organisms found within the tissues in puerperal fever have the form of micrococci, or round bodies, either single, or united in chains or clusters. These are found mingled with pus cells in the cellular tissue and lymphatics. They constitute a large proportion of the diphtheroid deposits sometimes found upon lacerations of the genital canal. They are abundant in the purulent or semipurulent fluid found in the peritoneum, and have been seen also in exudations in the pleura, pericardium, aud ventricles of the brain. They are with difficulty discovered in the blood during life, but they form a large element in thrombi in the vessels, and are found in the Malpighian bodies of the kidneys. They have been observed also in the urine.*

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* For observations on the organisms of puerperal fever and septicæmia, see Waldeyer, Arch. für Gynæk., Band III.; Orth, Virchow's Archiv, Band LVIII.; Heiberg, "Die puerperalen und pyæmischen Processe," Leipzig, 1873; Doléris, "La Fièvre

The particular species of micrococci which have been found in puerperal fever are the micrococci of suppuration, which are found also in other cases of septicæmia or pyæmia. Streptococcus pyogenes has been most often noted, but staphylococcus pyogenes aureus, albus, and citreus have also been found. Septicæmia therefore, whether puerperal or not, is not a pathological entity like a zymotic disease, but is rather a group of allied diseases. The streptococcus pyogenes, however, has a greater power than the other cocci of penetrating deeply into living tissues; and it is so generally found, either alone or associated with other cocci, that it deserves to be regarded as the organism *par excellence* of the more severe and fatal forms of puerperal septicæmia. Besides the cocci, the bacillus coli communis is capable of acting as a septic microbe in certain conditions. When the vitality of tissues is impaired, and especially when the intestines are also distended from inhibition of peristalsis, it appears to be capable of penetrating the intestinal wall, and multiplying in peritoneal or other effusions, in the neighbourhood of intestine. The gonococcus and pneumococcus appear to be also capable of acting as septic organisms under certain circumstances.

The influence of microbes in the production of puerperal septicæmia is not, however, fully explained by the study of them, either as regards their microscopic appearance, or their behaviour in cultures. For these organisms are found in simple local abscesses, even in a furuncle, they are common on the skin, in the mouth, and in other places, and, sometimes at any rate, occur in the vagina, even when no previous digital examination has been made. According to Steffeck they are actually found in about half the cases in the vagina of pregnant women, not previously examined. But it is not found clinically that there is the same risk of conveying contagion either to a puerperal woman or to a case of surgical operation from a simple abscess or from a furuncle, as there is from a previous case of puerperal fever, from one of phlegmonous erysipelas, or septic peritonitis. Some authorities have supposed that there are five or six species of streptococcus, indistinguishable morphologically, and differing only in their pathogenic effects. The more probable view, however, and that more generally accepted, is that there are not distinct species, but, at the most, only varieties; and,

puerpérale et les Organismes inférieurs," 1880; C. Braun, Lehrb. d. gesammt. Gynæc., Wien, 1881; Lomer, American Journ. of Obstet., July, 1884; Klein, "Septic organisms in relation to pathogenic," 1884; Hauser, "Relation of putrefactive bacteria to septicæmia," 1885; Thorn, Volkmann's Sammlung, No. 327; Hegar, Ibid., No. 351; Cheyne Watson, "Recent researches on micro-organisms in relation to suppuration and septic diseases," New Syd. Soc., 1886; Crookshank, "Bacteriology," 3rd ed., 1889; Watt Black, "Inaugural address," Obstet. Trans., 1891. Cornil, Centralbl. für Gynäk., 1889, p. 223; Clivio and Monti, *ibid.*, 1889, p. 245; Lustig, *ibid.*, 1889, p. 246; Bumm, *ibid.*, 1889, p. 723; Mironow, *ibid.*, 1890, p. 679; Döderlein, *ibid.*, 1891, p. 39.

further, that such varieties are not stable, but that a virulent variety may arise by the multiplication of the microbes under circumstances specially favouring their growth and vigour. Thus an intensity of virulence appears to be attained most of all in the body of a puerperal woman, to some extent also in the exudation of septic peritonitis, even apart from the puerperium, in tissues affected by phlegmonous erysipelas, and probably also in patients suffering from certain zymotic diseases. Microbes derived from such sources not only more readily implant themselves in the tissues, but set up a more severe and fatal form of disease. It is possible also that they retain their vitality longer, and are less easily destroyed by germicides. This view is supported by such facts as the modification of variola into vaccinia, the variation in the virulence of contagious diseases in different epidemics, or in different stages of the same epidemic, as well as the change in the virulence of the organisms of certain diseases which has been produced experimentally by cultivation in different fluids.

Organisms, in puerperal fever as in other diseases, may produce their effect in three ways :—(1), by producing in their growth some substance which has a poisonous effect ; (2), by consuming oxygen or other materials required by the body ; and (3), mechanically, by forming plugs which block small vessels or lymphatics. It is probable that, in most cases, all the modes of action are combined, the first being the most important.

Varieties of puerperal fevers.—Infection from decomposed or septic material may occur either by absorption of chemical products of decomposition which have a poisonous effect, or by the entrance of organisms into the tissues or into the blood, and their multiplication there. In the first case, if the source of poison is removed, the animal quickly recovers from its effects, if an almost immediately fatal dose has not been absorbed. In the second case, multiplication is likely to go on notwithstanding the removal of the source of infection. The body has, however, a certain power of resisting the growth of parasitic organisms. In experiments on animals, it has been found that the effect of septic fluid containing organisms injected into the blood is generally transient unless the quantity injected is considerable. A smaller quantity injected into the cellular tissue may prove ultimately fatal, since the organisms multiply in the cellular tissue, and thence supply poison continuously to the blood and lymphatics.

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(2) E
OF C

Sapræmia, or septic intoxication; and septicæmia, or septic infection.—The most essential division therefore of puerperal fever is into two main classes. (1) Sapræmia, or septic intoxication, in which a chemical poison only is absorbed ; (2) septicæmia, or septic infection, in which organisms multiply in the tissues, or in the blood, or in both. The slightest degree of septic intoxication is seen when wounded surfaces suppurate and become inflamed in consequence of the presence of the ordinary bacteria of decomposition on the surface, not within the tissues. More severe forms may arise when foul-smelling material is produced by decomposition of retained placenta or clots, or of the lochial discharge.

Septic organisms capable of multiplying in the tissues may be derived from other cases of puerperal septicæmia, septic discharges from wounds, surgical septicæmia or pyæmia, post-mortem poison from autopsies of patients who have died from diffuse inflammation such as peritonitis, and zymotic diseases. It is probable that similar germs may be casually present in dust, and so may be conveyed to the genital canal. There may be also special germs present in the air of certain houses or localities, as for instance from the effect of defective drains or other insanitary conditions. The septic infection may be limited to a special tract of tissue and produce inflammation there, or the organisms may multiply in the blood, and so constitute septicæmia proper. Pyæmia is produced if they form foci of inflammation in distant parts. Pyæmia is therefore not so distinct from septicæmia, as septicæmia is from sapræmia. It is rather a later stage of septicæmia, when the disease is not quickly fatal.

Sapræmia and septicæmia cannot always be practically distinguished. Sometimes, indeed, when decomposed material has been removed from the uterus, especially retained placenta after an abortion, febrile symptoms disappear within a few hours, and it may then be inferred with probability that nothing beyond sapræmia existed. In general, if any decomposed material such as clot or placenta is found in the genital canal, it may be hoped that any febrile condition existing is due to sapræmia, and that no virulent microbes have been introduced.

The distinction of septicæmia and sapræmia has somewhat superseded the old classification of septicæmia into autogenetic and hetero-genetic forms, since in all cases the microbes must have come originally from the outside. Yet a valuable practical distinction does remain between cases in which the main cause is the leaving placenta or clot to decompose, or lowering the vitality of the tissues by traumatism, and those in which it is the introduction of septic germs. Just in the same way peritonitis after ovariotomy may result either from a quantity of blood being left in the peritoneal cavity, or from virulent septic germs being conveyed by the surgeon or derived from the locality. The hetero-genetic form of puerperal infection corresponds to septicæmia proper; the autogenetic form often to sapræmia, but not always, for the decomposing material may have afforded a nidus for septic micrococci to multiply, and afterwards gain access to the tissues. Moreover, sapræmia predisposes to septicæmia by diminishing the resisting powers of the body.

Causation.—*Site of absorption.*—The site of absorption may be the uterine surface, especially the placental site, or lacerations of the cervix, vagina, vulva, and perineum. Probably the main reason why primiparæ are so much more liable to puerperal septicæmia is that, in them, some laceration of the vaginal outlet is inevitable, and more extensive laceration is common. During and even before labour infection may be conveyed to the cervix or vagina through some slight abrasion made by digital examination.

Chemical poisons may not only be absorbed from the products of bacterial growth in the genital canal, but may be formed in the body itself. Owing to the rapid absorption accompanying the involution of the uterus, a large quantity of effete material is poured into the blood, to be disposed of by the excretory organs. This must be the reason why, in the puerperal state, there is such a proneness to the outbreak both of septicæmia and zymotic diseases. This proneness is much more marked at the full term of pregnancy than in the earlier months, the uterus then having attained a greater size. Decomposition of retained placenta after an abortion, though it often leads to febrile disturbance and local inflammation, yet is much more rarely followed by fatal septicæmia than the same condition after full-term delivery. Excessive muscular exertion and expenditure of nervous energy also induces a peculiar state of the blood and tissues, more prone than usual to decomposition, as has been noticed in the cases of hunted animals and overdriven cattle. It is probaby due to the waste products formed. This cause will operate after prolonged or difficult labour.

If there be any deficiency in the excretory organs, effete materials are likely to accumulate in the blood, and probably, like sapræmia caused by absorption, predispose to septicæmia by diminishing the vital resistance of the body. Thus it has been observed that diseases and even functional disturbances of the kidneys and liver predispose to puerperal septicæmia. The term *endogenetic toxœmia* has been applied to the condition resulting from poison generated within the body. Some transient febrile disturbances may be purely of this nature, but it hardly exists as a separate variety of grave puerperal fever, though it may be one of the predisposing causes of septicæmia.

It must be remembered also that even true septicæmia may possibly arise without absorption from without. Septic germs may, if not commonly, yet occasionally, be present within the body, especially in debilitated subjects. Although, under ordinary circumstances, they are prevented from multiplying, yet they may do so in damaged tissues. Only in this way, for instance, can suppuration in an ovarian tumour which has never been tapped be accounted for. So, in the puerperal woman, this may be a possible origin for septicæmia after difficult labour, when the tissues have been much bruised.

Relation of erysipelas to puerperal fever.—It was held at one time that the streptococcus of erysipelas, first described by Fehleisen, was a specific microbe peculiar to that disease. Hence it was thought that the origination of puerperal septicæmia by contagion from erysipelas was an instance of a zymotic disease being converted into septicæmia. Since, however, the streptococcus of erysipelas cannot be distinguished from streptococcus pyogenes, either microscopically or by cultivation, the prevailing opinion now is that the two are either identical, or are varieties only, of which one may be converted into the other. Thus cutaneous erysipelas differs from septic inflammations only in the fact that the microbe is limited to the skin, and phlegmonous erysipelas is, in all cases, a septic cellulitis. Erysipelas may commence at a laceration at the outlet of the genital canal in a puerperal woman, and is very apt to be followed by septic inflammation of more internal parts. Thus in most cases there are symptoms of more or less inflammation of the pelvic organs and peritoneum, namely, tenderness of the uterus, and tenderness and distension of the abdomen. The disease is a dangerous one, the mortality being similar to that of ordinary puerperal septicæmia. Erysipelas may occur in other parts of the body, as in the face, and may run a favourable course, without any complication affecting the genital canal. But in some of these cases also, local inflammations occur, similar to those of ordinary puerperal septicæmia. These may perhaps be explained by accidental conveyance of contagion from one part of the body to the other. Again, in some cases presenting the general aspect of puerperal septicæmia, an erythematous or scarlet rash appears in limited blotches, not diffused like the rash of scarlatina. The cases in which they occur are generally severe and often fatal. Out of 354 cases of puerperal pyrexia, reported to the Collective Investigation Committee of the British Medical Association,* there were 8 in which erysipelatous rashes occurred. In these there were 3 deaths, or 37·5 per cent. Besides these there were 6 cases, of which 5 were fatal, in which an erythematous rash appeared in limited blotches.

There is considerable evidence to show that the contagion of erysipelas may produce in the puerperal woman not only erysipelas, but ordinary puerperal septicæmia without any erysipelatous rash. Thus it is recorded by Dr. Playfair that, at King's College

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* See "Report on Puerperal Pyrexia," by the Author, Collective Investigation Record, Vol. II.

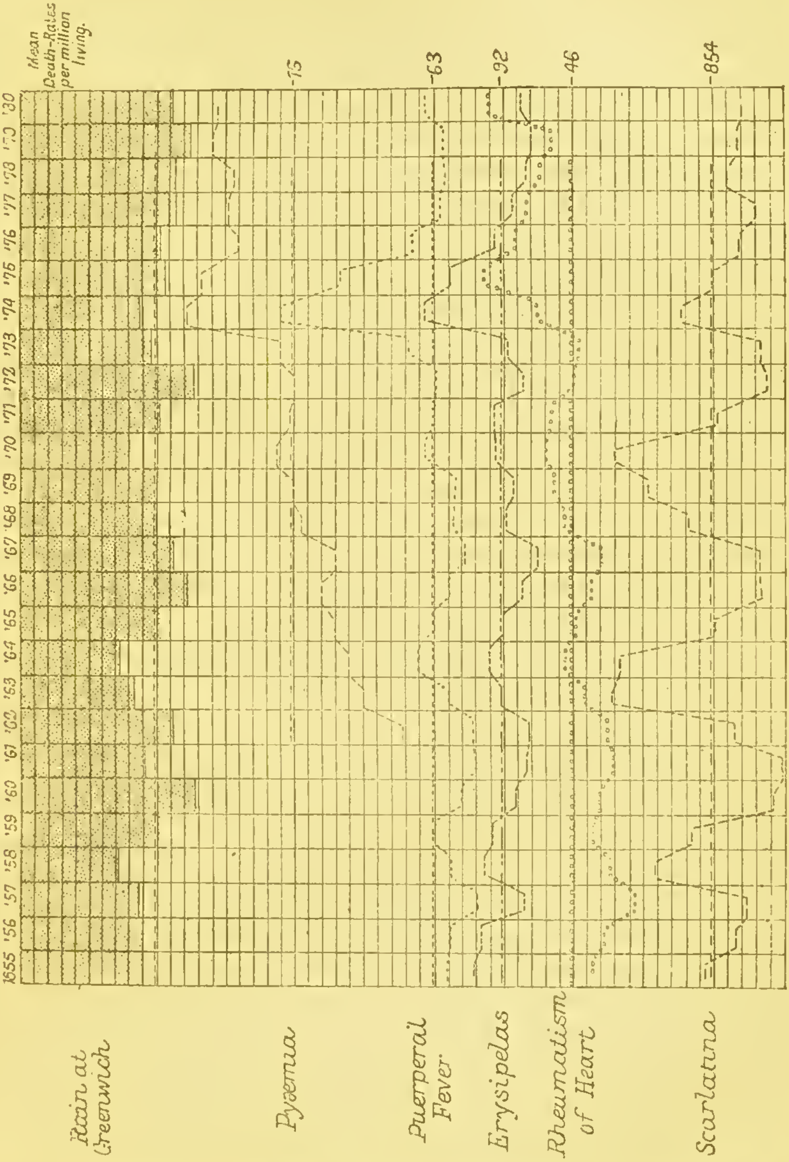

Fig. 270.—Death rates from erysipelas, scarlatina, and certain other diseases in England and Wales, with rain at Greenwich. (After Longstaff.)

Hospital, where a lying-in ward existed before the modern improvements in antiseptic midwifery, and had to be finally closed on account of the great mortality therein, puerperal fever proved fatal in direct proportion to the prevalence of erysipelas in the surgical wards. A series of instances in which, in small villages, an unusual prevalence of puerperal fever was coincident with epidemics of erysipelas, was collected by Minor.* A striking example, which occurred at the Rotunda Hospital, Dublin, has been recorded by Dr. Atthill.† A patient suffering from erysipelas was admitted at a time when the hospital had been quite free from any puerperal septicæmia. Although the patient was removed the next day, of the next ten patients delivered, nine suffered from puerperal peritonitis. Again, when the mother suffers from puerperal fever the child is sometimes affected by erysipelas. Dissection wounds, made at the necropsy of patients who died from puerperal fever, have given rise to phlegmonous erysipelas. A case was recorded in Italy, in which a husband had intercourse in the puerperal period with his wife, who afterwards died from puerperal fever. The husband had phlegmonous erysipelas of the penis, which spread to the abdomen and proved fatal. The risk of infection appears to be greatest from phlegmonous erysipelas in which suppuration occurs, and there is a discharge by which hands or clothes may be contaminated. Several cases have been recorded in which practitioners while attending to wounds of this nature have had a series of cases of puerperal fever in their practice.

Dr. Matthews Duncan‡ contended that puerperal fever could not be due to contagion carried from erysipelas or scarlatina, on the ground that neither erysipelas nor puerperal fever are ever epidemic, and that an epidemic of scarlatina does not appreciably increase the mortality from puerperal fever. Dr. Longstaff,§ however, has shown that it is fallacious to compare, as Dr. Matthews Duncan did, the absolute mortality of a common disease like scarlatina, which, though having only a low percentage of mortality, kills from 200 to 1,500 per million living, with that of comparatively rare ones, like erysipelas, which kills from 50 to 150, and puerperal fever, which kills from 40 to 130 per million living. Dr. Longstaff's statistics, embodied in curves representing the percentage above or below the mean of deaths from various diseases, show that both erysipelas and puerperal fever vary nearly as much in prevalence as scarlatina (Fig. 270). They show further that from 1855 to 1880 the curves of puerperal fever and erysipelas are almost identical, and show a close resemblance to the curve of pyæmia. There is a similar resemblance in the annual curves of the two diseases, both having a maximum from November to February, and falling below the mean in the summer.

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* American Journal of Medical Science, 1875.

† Medical Press and Circular, April, 1877. For a collection of similar evidence, see Nunneley, "On the Nature, Causes, and Treatment of Erysipelas," pp. 68–90.

‡ "On the alleged occasional epidemic prevalence of puerperal pyæmia or puerperal fever, and of erysipelas," Edin. Med. Journ., March, 1876.

§ "Studies in Statistics."

These curves are a strong confirmation of the modern view, derived from a study of the microbes, as to the close relation between erysipelas and septicæmia. Another curve however shows a close resemblance to those already mentioned, which would perhaps not have been anticipated, namely, that of rheumatism of the heart, and the maxima of this, as of the other curves, correspond to minima, not to maxima of rain at Greenwich. This resemblance of the curves may be explained either on the ground that fatal cardiac complications in rheumatism are due to secondary infection with streptococci, or that similar climatic conditions favour the prevalence of different organisms. That the maxima of all these diseases tend to occur in the driest seasons, and the minima in the wettest, seems rather to point to the diffusion of contagion by means of dust.

Out of 354 cases of puerperal pyrexia, reported to the Collective Investigation Committee, 17 cases, not showing the symptoms of erysipelas, were ascribed to contagion from that disease. The mortality of these was 70·6 per cent., a much higher one than the general mortality of all the cases, namely 47·7 per cent.

Relation of Scarlatina and other zymotic diseases to puerperal fever.—Scarlatina is the zymotic disease which occurs most frequently in the puerperal woman, and it shows in her certain peculiarities. Pregnant women appear to have a special immunity from, and puerperal women a special liability to the disease. Thus Olshausen* found only 7 cases recorded of scarlatina during pregnancy, as compared with 134 within one week after delivery. The peculiarity in puerperal women is that the sore throat is almost always slight, but yet the mortality is high, compared with the usual mortality of scarlatina, and corresponds rather to that of puerperal fever. In 134 cases collected by Olshausen, it was 48 per cent.; in 34 cases observed at the Rotunda Hospital, Dublin, by M'Clintock,† it was 29·7 per cent.; in 25 cases observed by Halahan‡ in private practice, it was 76 per cent.; in 13 cases recorded in the Collective Investigation Record, it was 30·7 per cent. In a series of cases in Queen Charlotte's Lying-in Hospital, observed by Brown,§ the complaint was quite slight in all, and there was no death. In fatal cases of puerperal scarlatina some of the symptoms usual in puerperal fever, such as tenderness and distension of abdomen, and scanty or offensive lochia, are not unfrequently present.

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* "Puerperal Scarlatina." Obstet. Journ., Vol. IV.

† Dub. Quart. Journ. Med., 1866.

‡ Dub. Quart. Journ. Med., 1863.

§ Brit. Med. Journ., Feb. 8, 1862.

Since the introduction of improved antisepsis in lying-in hospitals, some series of cases of scarlatina in such hospitals have been recorded in which there was little or no mortality, and no puerperal septicæmia resulted.* The conclusion suggested is that the chief danger of puerperal scarlatina is that it predisposes to septicæmia as a complication. It may be hoped that, with modern perfection of antisepsis, the dangerous character of the disease may be much diminished. Further experience, however, is required to confirm this, since the favourable result in one or two series of cases may have depended upon a mild type of the disease.

The opinion was not long ago widely held, especially in this country, that the contagion of scarlatina, like that of erysipelas, may give rise to a disease indistinguishable from ordinary puerperal fever. On the Continent, this has been denied; and it is now generally admitted, even in Britain, that the risk of contagion of scarlatina setting up puerperal fever has been, at any rate, exaggerated. There are obvious possibilities of fallacy in ascribing the origin of puerperal fever to scarlatina. Scarlatina being common, it must often happen that a practitioner who has a case of puerperal fever has been attending cases of scarlatina, without any connection necessarily existing. Cases like the following, recorded by Atthill, afford more evidence in favour of such a view. On May 16th, 1875, a patient died of scarlatina in the Rotunda Hospital, Dublin, having suffered from the disease a few days before she died. The sanitary condition of the hospital was previously good, but, on the 17th, there were two deaths from puerperal fever, followed by seven more between that date and June 3rd.

Dr. Longstaff's curves show some degree of coincidence in the fluctuations of scarlatina and puerperal fever, but nothing like the resemblance which the curve of puerperal fever has to that of erysipelas and that of rheumatism of the heart and pyæmia (Fig. 270, p. 780). The curve of scarlatina seems however to show something of the same tendency to vary inversely to the annual rainfall. Again, the annual curve of puerperal fever, while agreeing with that of erysipelas, differs from that of scarlatina, which has its maximum about two months earlier, in October or November. It may be inferred that the contagion of scarlatina cannot be an important element in the causation of puerperal fever; but it does not follow that there may not be a connection in some cases.

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* "Scarlatina during Pregnancy and the Puerperal State," by Dr. Boxall, Obstet. Trans., Vol. XXX.

Dr. Boxall's series of cases, in which, in a lying-in hospital, scarlatina produced only scarlatina, and caused no puerperal fever, and did not raise the average of puerperal pyrexia, affords important evidence against the origination of puerperal fever from scarlatina. But if the view held by some be true, that infection from a case of scarlatina can only set up puerperal septicæmia when the contagion is conveyed to the genital canal, the inference becomes less conclusive. For the modern antiseptic precautions would probably prevent such a mode of conveyance.

It is of significance that modern researches have shown that secondary microbes are generally present in scarlatina, and are the cause of many of the secondary lesions. Septic infection may therefore be derived from a case of scarlatina, as for instance, from a sloughy throat, and may give rise to puerperal septicæmia.

Again, the possibility can hardly be denied that scarlatina may occur in a puerperal woman, as it may in other persons, in such a masked form as to be not readily distinguishable; and that, if complicated by septicæmia, it may closely correspond in aspect to ordinary puerperal fever. Thus cases occur, in which, combined with local symptoms found in puerperal septicæmia, there is a scarlet rash, more or less evanescent, accompanied or not by a slight sore throat. It is almost impossible to say whether these cases should be regarded as scarlatina complicated by septicæmia or septicæmia alone. Eight such cases, besides 13 of undoubted scarlatina, were reported to the Collective Investigation Committee, and 4 out of 8 were fatal.

The contagion of diphtheria involves a similar risk to the puerperal woman to that of scarlatina. For streptococci are generally present in the diphtheritic membrane, and thus septicæmia might be set up. Also it is possible for true diphtheria to be conveyed to a wound in the genital canal. Any secondary lesions due to streptococci in other zymotic diseases, such as enteric fever, may also set up puerperal septicæmia. Any febrile disease in the puerperal woman favours the occurrence of septicæmia. Thus even the slighter zymotic diseases may have this effect, either through the pyrexia simply, or through some other effect upon the condition of the blood. Pneumonia is specially liable to be attended by septic inflammation in the pelvis. It is not known whether this is always due to a mixed infection produced by other organisms; but the pneumococcus has been found in other instances to act as a septic organism. There might be danger therefore to a puerperal woman of contagion derived from the sputa in pneumonia.

Effect of difficult labour.—If tissues are severely damaged, as by bruising or prolonged pressure, they lose more or less their faculty of resisting the multiplication of organisms within them. Hence after difficult instrumental delivery, or too prolonged unassisted labour, the tissues are apt to be infected even by microbes which are commonly present in the vagina. In this way may be produced either sloughing of the tissues with decomposition and consequent sapræmia; or septicæmia, if there happen to be any micrococci of suppuration in the vagina. Thus difficult labour may be followed by peritonitis similar to that resulting from conveyed contagion. The proneness to the reception of any conveyed contagion is doubtless also increased by bruising of the tissues.

Decomposition of retained placenta, clots, or lochial discharge.—From this cause sapræmia is generally produced in the first instance, but septicæmia may eventually result, the decomposed organic material having furnished a nidus for the multiplication of cocci either previously present in the vagina or introduced. The true nature of the case is often proved by rapid improvement following the removal or expulsion of the putrid material. An offensive lochial discharge does not in itself necessarily prove autogenetic origin, and the absence of any conveyed contagion from a virulent source, for it may be secondary to the conveyance of contagion. Thus an offensive discharge is not unfrequently noted in cases due to contagion from puerperal septicæmia, and even in those of actual erysipelas or scarlatina. If the offensive discharge occurs early and precedes the febrile symptoms, there is ground for thinking it probable that the case arises from decomposition of some retained material. Improvement following the use of vaginal or intra-uterine injections affords further evidence in the same direction.

Cold, exposure, or over-exertion.—In a certain number of cases there is a definite history of the commencement of pyrexia immediately after over-exertion, exposure, or cold; as for instance, when a patient gets out of bed within a few days after delivery and is then exposed to cold. Probably in most of these cases there is already some local lesion, the healing of which is unfavourably affected by the effect of the cold. In others the cold may set up an endometritis or vaginitis, which may take on a septic form.

Shock or emotion.—It is well known that the effect of mental excitement, shock, or emotion in a puerperal woman is often to cause a transient elevation of temperature. In a few cases a much more serious effect is produced, and such an influence appears to be the starting point of severe and even fatal septicæmia. I have known a case in which, so late as the 14th day, a lady was greatly agitated by one of her children, alone in the room with her, being nearly choked by a grape. Pyrexia commenced from that time and ended fatally. It is probable that in these cases, as in those originating apparently from cold, exposure, or exertion, there is generally some latent local lesion, which is unfavourably influenced by the effect of the emotion.

Contagion from puerperal septicæmia.—There is little doubt that the most dangerous contagion to the puerperal woman is that derived from some of the forms of puerperal septicæmia itself. This is most strikingly shown by the series of cases which sometimes occur in the practice of the accoucheur or midwife, as well as by the experience of lying-in hospitals. Of the 354 cases reported to the Collective Investigation Committee, 24 were placed in this group. These show the same peculiarity as the cases ascribed to the contagion of erysipelas, namely a mortality much above the average—70·8 per cent.

Other sources of contagion.—Other undoubted sources of contagion are post-mortem poison and discharges from wounds, especially if associated with diffuse cellulitis. Gonorrhœa should probably be also included, as the gonococcus, which is believed to be its cause, is allied to other microbes of suppuration. I have met with a case in which a husband admitted having infected his wife with gonorrhœa shortly before delivery. The child's eyes were destroyed by purulent ophthalmia, and it died of pyæmia. The mother suffered from puerperal peritonitis, but recovered. In general it appears that, as in the non-puerperal state, the gonorrhœal poison tends rather to cause limited plastic peritonitis than general septicæmia. Any decomposing matter may also be a source of danger. But, in the case of post-mortem poison, it appears that a much more virulent infection is derived, within a short time after death, from cases of septicæmia, or any diffuse inflammation, such as peritonitis, than from mere products of decomposition. This is explained on the ground that septicæmia is due to special micrococci, not to the bacteria of decomposition. But probably cocci may also be present, as saprophytes, in decomposing organic material.

Contagion derived from any source of suppuration may cause fatal infection to the puerperal woman. Thus the case has been recorded in America of a medical man who had repeated series of cases of puerperal septicæmia in his practice, notwithstanding disinfection and long abstinence from practice; and this has been attributed to his having suffered from chronic ozæna. In a similar way the discharge from a sinus at the root of a tooth, or the sputa from a phthisical lung, may be a source of danger.

Insanitary conditions.—Insanitary conditions in the house, especially defective drains, and want of cleanliness, are often found in association with puerperal fever. Such conditions may either act merely as a predisposing cause, by impairing the patient's health, or some poison may be produced which is the direct agent in contagion. In general, it is difficult to obtain positive evidence of the causation; but sometimes rapid improvement follows the removal of the patient to another house, or the repair of the defective drain. There is then evidence that some continuous poisonous influence was being exercised. This, however, could hardly be of the nature of septicæmia, which would not be likely to be cured, when once implanted, by removal of the original cause. Epidemics of puerperal septicæmia in lying-in hospitals have, however, been attributed to defective conditions of their drains, or to collections of insanitary refuse in their immediate neighbourhood. This is better evidence that defective drains may originate actual septicæmia. If cocci are present as saprophytes in decomposing matter, they may be introduced by sewer gas; and then may be disseminated in the form of dust, and reach the vagina even without being introduced by hand of accoucheur or nurse. Streptococci have actually been detected in dust; and the occurrence of maxima of puerperal septicæmia in dry seasons is evidence in favour of dust playing some part in its dissemination. At any rate, it is certain that streptococci not distinguishable microscopically from the pathogenic kind do occur as saprophytes.

Contagious character of different varieties.—Since puerperal septicæmia includes many varieties of disease, it may be expected that the contagious character would vary in different cases, and this expectation is confirmed by observation. When there is septic intoxication or sapræmia only, without septic infection, there can be no contagion. In localised forms of inflammation, such as the ordinary pelvic cellulitis, although micrococci may be present, there appears to be practically no risk of contagion. Much has yet to be learnt about the circumstances which render one variety more contagious than another. But two facts are established: (1) that forms of puerperal fever themselves derived from contagion are most likely to be contagious; (2) that very severe and fatal forms are more likely to be contagious than milder forms. Thus of 19 cases reported to the Collective Investigation Committee, which were the probable source of contagion to others, all but one were fatal. There may be contagion not only to other puerperal women, but to the infant or attendants. The infant may die from pyæmia, sometimes from erysipelas. Nurse or accoucheur may suffer from sore throat or poisoned hand.

Pathological anatomy.—The local lesions in the different forms of puerperal fever are very various, and depend upon the site of absorption, and the mode in which the poison spreads. Generally there are inflammatory changes in the genital canal and its neighbourhood, and in the peritoneum. But in the most severe forms of disease, the poison, reaching the circulation either through the veins or lymphatics, may set up so intense a septicæmia that death results with little or no production of any local lesions. The local changes will be described according to the tissues in which they are found, commencing with those most directly exposed to the poison.

Vaginitis.—Puerperal ulcers.—Wounds of the vaginal mucous membrane acquire an unhealthy appearance and suppurate instead of healing. Frequently the surface becomes covered with a dirty-looking, greyish deposit, and the edges and surrounding tissue become œdematous. Thus are constituted the so-called "puerperal ulcers." They are most frequently situated at the site of a perineal laceration. Sometimes sloughing of the damaged tissue occurs, especially if extensive bruising has taken place. Lacerations of the cervix may be converted into ulcers, in the same way as those of the vagina.

Diphtheritic ulcers.—Sometimes the ulcers become covered with a diphtheritic or diphtheroid deposit. In this streptococci are abundantly present, and it is associated with a deeper destruction of tissue than is usual in the ordinary ulcers. These diphtheritic ulcers are rare in isolated cases, but in some outbreaks of puerperal fever, especially in lying-in hospitals, they occur in almost all cases. They do not appear to be associated with the ordinary throat-diphtheria, nor does the membrane contain the bacillus of diphtheria. True diphtheria may however occasionally affect the genital canal. In association with the ulceration of lacerations, there is often general inflammation of the whole vaginal mucous membrane, which becomes congested and swollen.

Endometritis, metritis, salpingitis.—Changes in the uterus are the most generally present of all local lesions. The uterine wall is always soft and œdematous, the involution deficient. The mucous membrane is generally inflamed, often broken down completely into sanious débris, so as to lay bare more or less completely the muscular wall. The placental site is apt to be specially affected. Sometimes the internal surface appears gangrenous. In other cases there are limited ulcers, which may be covered with a diphtheroid deposit, as in the vagina. The inflamed mucous membrane contains cocci in abundance; streptococci, when present, penetrating most deeply into the tissue. The inflammation may extend along the Fallopian tubes, so that these become filled with purulent fluid. One of the modes in which peritonitis may arise is by extension of this inflammation along the tube to its fimbriated extremity, or through the substance of the tube-wall.

In some cases there is nothing beyond œdema of the muscular wall of the uterus. But in general the tissue is infiltrated with sero-purulent fluid. The lymphatics are specially affected. Sometimes they may be seen under the peritoneal surface, distended with pus, more especially where the peritoneal covering of the uterus is looser, as towards the sides, near the broad ligaments. Obvious affection of the veins is less frequently seen, but sometimes the thrombi in the sinuses become broken down, and pus is found in the veins. Small abscesses in the uterine tissue are occasionally formed.

B.

Pelvic cellulitis, or parametritis. — *Lymphangitis.* — The term "parametritis" is used to denote inflammation of the cellular tissue near the uterus, "perimetritis," to denote inflammation of the peritoneum covering it and in its neighbourhood. The word parametritis is therefore to be used as a synonym for pelvic cellulitis, although some authorities limit its use to inflammation of the tissue most immediately in contact with the uterus. The cellular tissue is liable to become inflamed by extension of inflammation from the uterus, especially at the sides where it joins the broad ligaments. Lacerations of the cervix, deep enough to reach the cellular tissue, are specially liable to be a starting point.

The bruising of the tissue in prolonged or difficult labour may also set up inflammation, and the damaged tissue then offers less resistance to the multiplication of organisms within it. In general the cellulitic inflammation is unilateral, or more marked on one side.

In the more severely septic forms of inflammation, the cellular tissue is infiltrated with turbid semi-purulent fluid, containing micrococci. The lymphatics are specially affected, and may be filled with pus. More rarely pus is seen in the veins. If the inflammation has lasted a few days, small collections of pus in the cellular tissue are visible to the eye.

In the less severe form of inflammation, which constitutes the ordinary pelvic cellulitis, the disease is limited, and does not lead to general septic infection throughout the body. In this case, the course is slower, and a greater amount of local swelling is produced. The swelling is due to the effusion, first of serum, then of lymph. Suppuration may eventually occur, or the lymph may be absorbed, leaving generally more or less fibroid induration. No positive line of distinction, however, can be drawn between the ordinary pelvic cellulitis and the cellulitis accompanying the more virulent forms of puerperal fever. The lymphatics and lymphatic glands always take an important part in the inflammation, and the latter are found to be swollen. In the milder forms of disease, the glands appear sometimes to interpose a barrier to the further spread of inflammation.

Parametritis may in other cases arise, generally at a later stage, secondary to salpingitis, especially when this goes on to the formation of a pyosalpinx. In such cases it is more frequently bilateral.

Site of the deposit in parametritis.—The development of the local inflammation is greatest in those cases which do not proceed to general septic infection, and which run a prolonged course. The inflammation generally spreads where areolar tissue is most abundant, that is, between the folds of the broad ligament, and thence to the iliac fossa. From thence it may ascend along the sheath of the psoas and iliacus muscles, or along the ascending or descending colon, according to the side affected, to the region of the kidney or the diaphragm. It may also come forward along the muscular sheath to Poupart's ligament, and thence ascend upwards, between the peritoneum and the abdominal wall. Inflammation may also extend in the cellular tissue surrounding the bladder, or in that between the pouch of Douglas and the vagina, or descend upon the vaginal walls. These courses, however, are more frequently taken by cellulitis of non-puerperal origin. When suppuration occurs, the abscess most frequently opens above Poupart's ligament. Sometimes it descends near the femoral vessels to the inside of the thigh. At other times it opens internally into the vagina, rectum, or bladder. Rarely, it opens beside the anus, or passes through the obturator or sciatic foramen.

Remote parametritis.—In some cases inflammation quickly subsides in the neighbourhood of the uterus, but proceeds to suppuration or to the formation of considerable deposit at some distant point to which it has spread. This condition has been called "remote parametritis." In such cases, an abscess or cellulitic swelling may be found in the abdominal wall, near the kidney, near the sacro-iliac joint, or elsewhere, while little or no thickening can be detected near the uterus.

Peritonitis.—Inflammation of the peritoneum is one of the commonest lesions, and, in most cases, it is this which forms the main feature of the disease. General peritonitis may arise through extension of septic inflammation to the peritoneum, through the medium of the lymphatics. The peritoneal cavity is then found to contain a turbid, foul-smelling fluid, containing micrococci, and more or less pus. There is tympanitic distension of the intestines from an early stage, and the peritoneum becomes roughened, as well as injected or marked by ecchymoses in the situations of least pressure. It is only in rapidly fatal forms of septicæmia, and in those in which infection takes place through the veins rather than through the lymphatics, that death may occur without the development of any sign of peritonitis.

Suppuration of the tubes, without closure of the ostium, is frequently the starting point of general peritonitis. More rarely a pyosalpinx of old standing ruptures during or after delivery and sets up peritonitis.

In milder forms of inflammation, the exudation is less purulent. More lymph is produced, and adhesions may be formed between coils of intestine or other organs. In spaces limited by such adhesions, collections of pus may be formed, and thus local abscesses be produced. Inflammation is generally most marked in the pelvic peritoneum.

Pelvic peritonitis or perimetritis.—When the septic infection does not spread to the peritoneum generally, the pelvic peritoneum may become inflamed through contiguity to inflamed tissues in the pelvis. Thus, in cellulitis, the peritoneum covering the broad ligaments becomes inflamed; and inflammation may also extend to the pelvic peritoneum, either through the substance of the uterus or Fallopian tubes, or reach it through the abdominal extremity of the tubes. In the limited form of peritonitis, the inflammation is generally of the adhesive kind, but localised collections of pus may be formed.

Ovaritis.—The ovaries are often especially affected in connection with septic forms of cellulitis and peritonitis. The ovary becomes swollen, the stroma infiltrated with turbid serum, and abscesses may be formed either in the stroma or in the Graafian follicles.

Thrombosis and phlebitis.—Thrombosis in the veins of the placental site is a normal condition after delivery. Thrombosis in uterine or pelvic veins is also not uncommon, apart from any septic infection. It is promoted by the special proneness to coagulate which exists in the blood of puerperal women, and by the enfeeblement of the circulation during rest in bed. If the thrombus remains healthy, it eventually becomes organised, and the vessel is partially or wholly obliterated. If, however, septic organisms are present, the thrombus becomes softened and breaks down, fragments of it are carried away in the blood stream, and are apt to form emboli in the lungs, which form the starting points of metastatic abscesses. Similar abscesses in the liver or kidneys may originate from emboli formed by clusters of micrococci, which have passed through the pulmonary circulation, or from fragments detached from thrombi formed in the heart or pulmonary veins, or may be secondary to ulcerative endocarditis.

Septic thrombi may be formed in the first instance in several ways. Organisms may reach the thrombi of the placental site from decomposing material within the uterus. Again, the presence of septic material in the blood may give rise to thrombosis in various parts. Or phlebitis may be set up in consequence of septic cellulitis of the tissue surrounding the vein. Thrombosis is then the consequence. The phlebitis may extend from the point obstructed by the thrombus, and the vein may then be found filled with pus.

Septicæmia.—In the most virulent forms of septic infection of the blood, death may be produced almost before there is time for the development of local lesions. Even peritonitis may in these cases be sometimes absent. The only changes then found at an autopsy are an altered state of the blood, in consequence of which the lining membrane of the arteries becomes stained with blood pigment shortly after death, and softening and swelling of glandular organs such as the spleen, liver, and kidneys. The spleen and liver are most affected, and the spleen especially may be almost diffluent.

Secondary affections: Pyæmia.—If the disease lasts long enough, secondary affections are apt to be developed, but the more virulently septic forms of it are generally so rapidly fatal that it is only in a small proportion of cases that the type of pyæmia is assumed. Pyæmic deposits in the viscera, and pyæmic inflammation of more external parts, such as the joints, are not often found associated together. The former belong to those cases in which the spread of the poison takes place chiefly through the vessels, producing emboli, the latter to those in which it spreads through the lymphatics. As might be expected, pyæmic deposits are commonest in the lungs, since emboli originating from thrombi in the veins are likely to be arrested there. Next to the lungs the organs most often affected are the kidneys. General septic nephritis may also occur.

Ulcerative endocarditis is occasionally found, but is comparatively rare. Micrococci are found in the ulcerated tissue, and secondary embolic foci of inflammation are apt to result in various parts.

Septic panophthalmitis is the result of embolism of the ophthalmic artery. It leads to suppuration and destruction of the eye, and is generally followed by death.

Pleurisy and pericarditis may result from extension of inflammation through the diaphragm from the peritoneum, or may be secondary to pneumonia, generally of pyæmic origin.

Pneumonia may arise from metastatic pyæmic deposits. Bronchopneumonia and lobular pneumonia, apart from pyæmia, are also liable to occur in connection with septic disturbances after delivery.

Joints are not unfrequently affected by swelling and inflammation which may go on to suppuration, as in the case of surgical pyæmia. In other cases the pain and swelling are only temporary. The joints of the upper extremity, shoulders and elbows, are most frequently affected, next to them, the knees.

Local inflammation of cellular tissue, especially in the limbs, also occurs, often accompanied by redness of the skin over the swelling. The swellings may subside, or go on to the formation of abscesses. In some cases the inflammation is obviously due to embolism, and may then lead to vesication and even superficial sloughing.

Among the secondary affections sometimes observed are inflammation and suppuration of parotid or thyroid, suppuration of ears, and meningitis.

Of the 354 cases reported to the Collective Investigation Committee, there were 15 in which pyæmic abscesses in the joints or other external parts occurred, 20 in which there were signs of secondary pneumonia.

Symptoms and course.—In the great majority of cases, the disease commences within the first five days after delivery. The third day is the commonest day of onset, especially in cases arising from infection conveyed from some virulent source, such as puerperal fever or erysipelas. Puerperal scarlatina and erysipelas also appear most frequently on the third day. In the cases of puerperal pyrexia reported to the Collective Investigation Committee the days of onset stand in the following order of frequency: —third, second, fourth, first, fifth. In some cases, the pyrexia commences before delivery. In these it must be presumed that the infection is received at an early stage of labour, or previous to labour. Cases are comparatively rare in which the first outbreak is noticed after the end of a week. It is probable that, in most of these, there has been, at an earlier period, some local morbid action and some febrile disturbance which has escaped notice. The majority of them are either instances in which the outbreak of the fever is attributed to some exposure, premature exertion, or nervous shock occurring at a rather late period after delivery, or they are cases in which there is a late manifestation of a localised pelvic cellulitis, the early symptoms of which may have been slight in degree, and may easily have passed unobserved. The thrombotic form of septicæmia also begins to cause symptoms rather late, sometimes as much as a week after delivery.

The symptoms vary greatly according to the forms which the local manifestations of the disease assume. The most general symptom is the pyrexia itself. Most frequently the initial rise is rather sudden, to a height such as 105° F., or more. In this ease rigors accompany the rise, and often form the first serious symptom which attracts notice. When the rise of temperature is gradual, as from the slow decomposition of something retained within the uterus, rigors may be absent. In severe or fatal cases, the temperature quickly reaches a considerable elevation, such as 103° or 104° F. The pulse rises with the temperature. In moderately severe cases the rate may be as much as 120; in the graver forms of the disease, it may reach 140; and before a fatal issue may be as high as 160 or 170. As a rule the temperature tends to rise progressively towards a fatal issue. But in some of the most virulently septic forms of disease, especially when purulent peritonitis exists, the temperature falls again, after an initial rise, while the pulse continues to rise, and the general conditions become aggravated. The pulse is, therefore, frequently a more reliable sign of danger than the temperature. As the moribund condition is approaching, the temperature may become subnormal. In the more protracted forms of disease, which take the form of phlebitic septicæmia or pyæmia, there are usually great oscillations of temperature; and the successive elevations are often accompanied by repeated rigors, perhaps at intervals of several days. When the fever is continuous, the initial rigors are generally not repeated.

Next to the pyrexia, the most general symptom is tenderness of the uterus, accompanied by a deficiency of contraction and TE involution. Usually there is, in addition, pain referred to the uterine region, and indicating endometritis or metritis. Another symptom common to most forms of the disease is enlargement and tenderness of the spleen.

The tendency to delirium is slight in proportion to the degree of pyrexia, compared with that which occurs in many other forms of fever. When fever is high there is generally more or less wandering at night, but the patient can usually be roused to understand and answer. In grave septicæmia, the face is anxious in expression, but the mind is often quite clear, and the patient may be quite unaware of her grave condition. Severe headache is common. The tongue may remain moist and clean, in slight attacks, but is generally coated, and eventually may become dry and glazy or brown. Sweating is frequent, especially when oscillations of temperature occur.

Among the most prominent of the graver symptoms are diminution or suppression of the lochia and of the milk. Frequently, but not invariably, the lochial discharge becomes offensive before LO it is suppressed, or at the earlier stage of its diminution in quantity. Such an offensive character in the discharge may either precede or follow the onset of the pyrexia. In rare cases, in which the fever commences before, or immediately from the time of delivery, there is an almost complete suppression of lochial discharge from the outset. Interference with lactation is not so general a symptom as some alteration of the lochial discharge, but there is diminution or suppression of milk in the graver cases of fever, if at all prolonged. If the onset of fever is early, on the first, second, or third day, the secretion of milk may be entirely prevented. In other cases, it diminishes and ceases as the constitutional state becomes grave.

Vomiting and diarrhœa, but especially the latter, are symptoms which generally indicate a severely septic form of fever. Vomiting is especially associated with general peritonitis, but may occur without evidence of peritonitis, as a symptom of the pyrexia, especially when the temperature rises to a high level. When diarrhœa occurs, the motions are often very offensive, as if some septic material were evacuated through the intestines. The diarrhœa does not generally commence quite at the outset, but after the disease has been established for a day or two.

Rashes.—A miliary eruption frequently results from the sweating which is usual in any form of puerperal pyrexia, even that of a slight and evanescent kind. Besides the rashes of definite zymotic diseases, others occur which often make it very difficult to say whether the complaint should be regarded as a zymotic disease or not. There may be an evanescent general scarlet rash, suggestive of the rash of scarlatina, but not always followed by desquamation. Again there may be limited erythematous blotches resembling, and probably identical with, erysipelas. In other cases a roseolous, papular, or petechial rash is observed. The latter forms of rash, at any rate, are to be regarded as merely symptoms of septicæmia, and generally indicate a grave and dangerous form of the disease.

The remaining symptoms must be described under the headings of the special varieties of fever.

General Peritonitis—General peritonitis is by far the most frequent variety. In this form, the rigor and rise of temperature are generally accompanied or quickly followed by acute abdominal pain and tenderness, commencing near the uterus and extending over the whole abdomen. The patient lies on her back with the knees drawn up, as in ordinary peritonitis. The abdomen becomes distended and tympanitic from paralysis of the sympathetic nerves. Sometimes individual coils of intestine may be seen standing out, and, before death, the distension often becomes enormous. Vomiting is frequent, and the contents of the upper part of the intestine are often ejected, as well as those of the stomach. Vomiting of coffee-ground fluid is a very unfavourable sign. The pulse is small and rapid, but soon becomes feeble rather than resistant. It is usually a more important indicator of danger than the temperature. At the early stage, and, in the less virulent forms of disease, throughout the whole course, the bowels are confined, as in ordinary peritonitis. But in the more virulent septicæmia, diarrhœa soon comes on, and the motions are frequent, liquid, and offensive. The skin becomes sallow, or has a yellowish tint, and there is a peculiar disagreeable smell about the breath. Pain and tenderness are symptoms not invariably present. In some of the gravest forms of septicæmic peritonitis especially, when the inflammation is of the suppurative kind, they are absent. The peritonitis then only reveals itself by the abdominal distension, associated with the rapid, feeble pulse, and frequently with vomiting and diarrhœa. Enough fluid may be present to give a manifest fluid thrill, and dulness in the dependent parts of the peritoneal cavity. In milder forms of fever, on the other hand, the pain and tenderness may not extend far beyond the neighbourhood of the uterus, or the general tenderness may be evanescent. Abdominal distension does not then proceed beyond a moderate degree. If a fatal termination is approaching, the extremities become cold, the hands pick at the bed-clothes, the pulse cannot be felt at the wrist, and the patient often becomes comatose. When the disease proves fatal, death usually occurs within a week, not unfrequently in four or five days.

If the course of the disease is protracted, and the peritonitis is of the adhesive form, tangible masses may after a while be formed in the abdomen through the matting together of coils of intestine. Sometimes suppuration takes place within a space limited by adhesion. An abscess is then formed which may point on the surface of the abdomen, or, less frequently, open into the intestine, vagina, or bladder. Such an abscess may leave a sinus which long continues to discharge. In some cases, apart from general pyæmia, a secondary abscess of liver has been formed.

Pure septicæmia.—In some cases the disease kills apparently by the intensity of the poison without the production even of peritonitis, and before there is time for any metastatic inflammations to arise. There is, however, almost invarably tenderness of uterus, as evidence of some local inflammation of that organ, and there may be "puerperal ulcers" in the vagina. The abdomen may become distended to some extent from the impression produced by the poison upon the sympathetic nerves, even though no evidence of peritonitis is found *post mortem.* There are rigors at the commencement, and pulse and temperature rise rapidly to a high level. Diarrhœa is common. There is an absence of pain, but a good deal of wandering of mind. Tenderness and enlargement of spleen may be made out. Death generally occurs in three or four days.

Sapræmia, or septic intoxication.—Sapræmia produced merely by the absorption of chemical products of decomposition, without the multiplication of organisms in the blood or tissues, is probably rarely seen in its pure form in the puerperal woman. The chief examples of it are to be found in cases of decomposition of retained placenta after premature labour or abortion, when the symptoms subside rapidly, sometimes within a few hours, after the removal of the source of mischief. I have, however, met with the case of a primipara who had severe rigors little more than twelve hours after delivery. Twenty-four hours after delivery, the lochia were suppressed, the pulse was 160, temperature 102° F., and the patient delirious. The case had all the aspect of the most virulent form of puerperal septicæmia derived from contagion. Since, however, careful inquiry failed to indicate any possible source of contagion, it was decided to wash out the uterus, although there was no evidence of decomposition. After twelve hours, the temperature had become normal, the pulse had fallen to 90, and the lochia had returned. The patient recovered without further disturbance.

The symptoms of sapræmia consist of the fever itself, frequently with the addition of effects commonly produced by pyrexia, such as vomiting, headache, pains in the back and limbs, sometimes delirium. Rapid recovery after the removal of some decomposing material can alone prove that the disease was solely or mainly sapræmia. But it may always be hoped that such is the case, when the pyrexia has been only recently developed, and when there is no evidence of local inflammation, such as peritonitis, or cellulitis.

Vascular or phlebitic septicæmia.—Distribution of poisonous material into the blood from septic thrombi may commence within two or three days after delivery, but frequently occurs only at a later period. Symptoms of a slight pelvic cellulitis may have preceded, or nothing abnormal may have been noticed. At the commencement there is usually a strong rigor, and sudden rise of pulse and temperature. The fever is not, however, continuous, but interrupted by remissions or complete intermissions. Profuse perspiration generally accompanies the fall of temperature, and thus the disease may resemble malarial fever. In the majority of cases there is no peritonitis, and the abdomen is then usually free from any general tenderness or distension. If a vaginal examination is made, a slight cellulitic thickening may often be felt near the uterus, but not sufficient to account for the degree of fever. Rigors are apt to be repeated with the successive rises of temperature. Recovery may take place without the production of any metastatic inflammation, or the disease may be merged into pyæmia. It is in this form of disease especially that pyæmic abscesses in lungs and other viscera are apt to be formed by septic emboli. The course of the disease is apt to be more protracted than other forms of puerperal fever. If it is converted into pyæmia, the fever becomes continuous, and the general condition more grave.

Pyæmia.—In all cases the course of which is protracted, metastatic inflammation is apt to arise. Such inflammation chiefly occurs in the cellular tissue, especially of the limbs, in the joints, and in the lungs and other viscera. Both inflammation of the cellular tissue and that of the joints may subside without going on to the formation of abscess. Out of 354 cases of puerperal pyrexia reported to the Collective Investigation Committee, there were 14 in which external pyæmic abscesses were formed. The mortality in these was 28·5 per cent., the average mortality of the whole number being 47·4 per cent. It therefore appears that, although a patient may sink from exhaustion from the suppuration of external abscesses, yet the cases in which these occur, being comparatively protracted, are not the most dangerous. The occurrence of pneumonia or pleurisy in the course of puerperal septicæmia does not necessarily imply the formation of pyæmic deposits in the lung, but it frequently does so, and is always of serious import. Out of the same 354 cases, secondary pneumonia or pleurisy was noted in 20 cases, the mortality of which was 70 per cent. Pericarditis is less frequently observed. It is also of serious import. Occasionally, both external and visceral pyæmia are combined in the same person.

Pelvic cellulitis (parametritis) and pelvic peritonitis (perimetritis).—Pelvic cellulitis and pelvic peritonitis are diseases which occur independently of pregnancy as well as in the puerperal state. By many authors the description of them is separated altogether from that of puerperal fever, on the ground that they do not necessarily arise from any septic origin. This is so far true that they may be due to a traumatic cause, such as the effects of difficult instrumental delivery. Even in this case, however, though there may be no special poison conveyed from without, yet the spreading cellulitic inflammation is probably associated with the presence of micrococci, especially in those cases which end in suppuration. The explanation may be that, when the vitality of the tissues is lowered by mechanical injury, organisms whose germs are commonly present are able to multiply in them. Again, parametritis not unfrequently appears to owe its origin to some exposure, or over-exertion, or coitus, too soon after delivery. But, in most such cases, the exciting cause only calls into activity a morbid process which had already existed in some latent degree. It is probable, therefore, that, in the puerperal woman, parametritis and perimetritis never occur altogether apart from some septic element, although there may have been neither any conveyance of special poison, nor manifest decomposition in the genital passages. Some degree of parametritis is often associated with grave forms of septicæmia. But, if the parametritis is extensive, and forms the main feature in the case, it is usually implied that there is no general septic infection; and that, if any special infection has been received, its effects are limited to the local inflammation. Parametritis is thus an example of a condition which cannot be excluded from the group of septic diseases, but yet the prognosis of which is generally favourable.

Apart from pregnancy, parametritis and perimetritis may, to a certain extent, be distinguished from each other, although they are often combined together. Perimetritis is then the most frequent; while, after delivery, parametritis is the commonest. In the puerperal woman, perimetritis is chiefly observed in conjunction with parametritis. The symptoms of the two will therefore be described together.

As in other forms of puerperal pyrexia, the onset is generally within the first five days. It is not, indeed, uncommon to meet with cases in which the onset is insidious, and which only attract attention at a much later period, sometimes several weeks after delivery, when the woman has begun to get about. But, in most such cases, there has been, shortly after delivery, pyrexia with slight pain, the cause of which has been overlooked.

The attack generally commences with rigor and sudden rise of temperature. The temperature commonly reaches 102° F. and may rise to 103° or 104° F. The pulse is not so frequent in proportion as in general septicæmia, and rarely exceeds 120. With the pyrexia commences pain and tenderness in the lower part of the abdomen, generally on one side. The degree of pain and tenderness depends much upon the extent to which the peritoneum is involved in the inflammation; and in some cases they are slight. The pain frequently subsides in a few days, while the tenderness remains. When the peritoneal affection is prominent, there may be also nausea and vomiting, an anxious expression of countenance, and some distension of the lower abdomen. If the exudation surrounds the bladder and rectum, pain on defæcation and micturition comes on at a later stage, and there is often vesical tenesmus. The bowels are generally constipated. If a mass is formed in the broad ligament, the patient lies with the thigh on the affected side drawn up, and cannot extend it without pain. There is also pain down the thigh, and in the lumbar region, from pressure on the nerves. The temperature generally reaches its height in two or three days. Its course afterwards is irregular, and there are usually morning remissions or intermissions, especially as the disease is subsiding. Profuse sweating often accompanies the remissions. While the pyrexia is considerable, there is usually headache and sleeplessness, and the tongue is coated. The fever may subside within a week, or may be prolonged with an irregular course for several weeks. Repeated rigors, with successive elevations of temperature to a high point, generally indicate suppuration.

Such inflammatory thickening near the uterus may be formed within a few days, but it is generally not till after a week that any considerable mass of exudation is formed. On vaginal examination a swelling is then felt, usually on one side of the uterus. It may be rounded or may be somewhat wedge-shaped, occupying the position of the broad ligament, the broad end of the wedge spreading out toward the pelvic wall, to which it is attached. Generally a laceration of the cervix may be felt on the side corresponding to the swelling. The dimensions and outline of the swelling can best be estimated by bimanual examination. The lateral vaginal fornix, and often, if there is accompanying perimetritis, the posterior fornix, are depressed by the exudation. The thickening may extend round the back of the uterus and reach the other side, or, more rarely, descend on the anterior vaginal wall, surrounding the bladder. The uterus is pushed toward the opposite side. Its mobility is diminished, and may be almost entirely lost, if the exudation extends around it. Fixation of the uterus is not, however, so marked a feature in pelvic cellulitis as in pelvic peritonitis, and its mobility is more quickly restored. If the exudation extends to the iliac fossa, it may form a swelling reaching several inches above Poupart's ligament, which is readily felt by external manipulation only, and is sometimes visible on inspection of the abdomen. The tendency to spread to the iliac fossa is much greater in cellulitis of puerperal origin than in that which arises apart from delivery.

If suppuration does not occur, the swelling becomes gradually harder and less sensitive, and then begins to diminish from absorption. At the height of the disease it feels rounded from the vagina; but, as it diminishes it becomes flatter on its lower surface, and sometimes concave or angular. When the mass has been absorbed, the uterus becomes drawn toward the affected side by contraction of fibroid tissue. The uterus may regain most of its mobility. It may be many months before the utmost attainable degree of absorption is reached, and some fibroid thickening may remain permanently, but often, after six or eight weeks, the swelling has almost entirely disappeared. Years afterwards, the relic of the disease may be felt in the shape of a fibrous band, generally starting from the angle of a cervical laceration outward to the pelvic wall.

If suppuration takes place, the disease is protracted for many weeks, hectic fever is established, and there is loss of appetite, and other signs of pus formation. It is often seven or eight weeks before the pus is discharged. The abscess generally opens a little above Poupart's ligament. More rarely it opens into the colon, rectum, vagina, or bladder. Such internal opening is more frequent in the case of a perimetric than in that of a parametric abscess.

If the suppuration has taken place within the sheath of the psoas and iliacus muscles from inflammation extending from the broad ligament, the abscess generally opens below Poupart's ligament, or near the crest of the ilium. Some authors have estimated that suppuration takes place in more than half the cases of parametritis, but probably the proportion is much less than this, if all slight cases are included. Suppuration is, however, more frequent in parametritis than in perimetritis.

The most characteristic local condition produced when the thickening is due to perimetritis not parametritis, is a uniform board-like induration of the whole roof of the pelvis, with the uterus firmly fixed in its centre or pushed very slightly forward by lymph in the pouch of Douglas. This is chiefly met with in cases arising apart from parturition or abortion. Peritonitis may, however, form a local swelling at the back, front, or side of the uterus, from a matting together of coils of intestine, and especially in one or both posterior quarters of the pelvis, due to matting of the tubes and ovaries, sometimes with distension of the tubes. If such a swelling extends at the same time far above the brim, not toward the iliac fossa, it is likely to be the result of peritonitis. The opening of an abscess at the umbilicus is also a sign of peritoneal origin.

After the opening of an abscess, the pain is generally quickly relieved, the fever subsides, and the sinus closes in a short time. Sometimes, however, if there is deep and extensive burrowing of pus, the sinus remains long open, and the patient may eventually sink. This is more likely to happen with an abscess of peritoneal origin.

Diagnosis.—Any elevation of temperature much above 100° F. in the puerperal woman, if not accounted for by some independent condition, such as inflammation of the breasts, should raise a suspicion as to the commencement of septic disturbance, although many such elevations prove to be evanescent. The rise of temperature is more significant, if accompanied by rigors and tenderness of the uterus. A pulse rapid in proportion to the temperature, a coated or dry tongue, headache and vomiting, are also signs pointing to septicæmia. If the progress of involution of the uterus is recorded in the way previously described, a check in the rate of diminution, especially if accompanied by pyrexia, is very valuable as an early sign of mischief. It may occur both in sapræmia and septicæmia. The pain due to commencing metritis or peritonitis is distinguished from after-pains by its continuous character, and by its being accompanied by tenderness, and a pulse more rapid than normal. Distension of the abdomen is a significant symptom, even in the absence of pain and tenderness. Diminution or suppression of lochia and milk generally point to developed septic inflammation, especially if the lochial discharge has previously been offensive.

Prognosis.—The relative mortality of some of the principal forms of fever has already been mentioned. The danger is greater when septicæmia, or apparent septicæmia, is due to conveyed contagion from some virulent source, especially when this is derived from other cases of puerperal septicæmia, or from erysipelas. The earlier the onset of the disease after delivery the worse is the prognosis, and it is still worse if the fever commences before delivery. When the fever commences after a week has passed, the prognosis is more favourable. The complaint is then more likely to turn out to be local parametritis, without general septic infection.

The gravest symptoms are signs of general peritonitis, great rapidity of pulse, very high temperature, dry tongue, severe vomiting, diarrhœa, and above all great tympanitic distension of abdomen. Diphtheritic deposit on vaginal ulcers, or in the throat, is an unfavourable sign. The most serious complications are pneumonia and pericarditis. With a given degree of pyrexia, it is a favourable sign to find a considerable local swelling of parametritis, for the pyrexia need not then be due to the more serious condition of general peritonitis, or to general septic infection.

Prophylaxis.—The most important points in prophylaxis are :—(1) To guard the puerperal woman from the access of any special infection : (2) to prevent the retention of any material liable to decompose or form a nidus for septic micrococci ; and (3) to secure, as far as possible, that the woman shall be in the best possible condition for resisting any morbid process, and that no unnecessary avenues shall be left open for absorption, and no avoidable injury done to the tissues.

The first thing, in point of time, is to promote the health of the woman before delivery. This, however, the physician may not always have the opportunity of carrying out. The sanitary conditions of the house and lying-in room are of special importance. Care should be taken that the drains are in order, and there is no access of sewer gas, or ill-arranged water-closet or sink near the room. Ventilation by abundant fresh air is of equal importance. This is proved by the fact that the frequency of puerperal septicæmia has a seasonal variation in proportion to the cold. Ventilation should be aided by an open fire whenever the weather is not warm enough to allow open windows. The utmost cleanliness should be observed in the lying-in room, and all soiled linen at once removed.

In labour, the patient should not be allowed to become exhausted by undue protraction, and timely aid by forceps should be given when required. On the other hand, it is of at least equal importance not to cause unnecessary lacerations by premature or hasty delivery with forceps when the head is delayed by the cervix or vaginal outlet. No rupture of the perineum should be allowed to remain without the application of sutures. It is of importance to secure a firm and permanent contraction of the uterus, that there may not be gaping orifices to afford ready access for any septic germs to reach the thrombi in the vessels, and that clots may not be allowed to remain and become decomposed within the uterine cavity. It has been recommended to administer as a routine practice in all cases, of a mixture containing quinine, ergot, and digitalis, with the object of maintaining uterine contraction. This does not seem necessary when the woman is strong and the uterus active, but it is very useful whenever there is any tendency to inertia. The plan already recommended (see p. 285) of not letting the patient remain too much in one position, and allowing her to kneel up to pass water after two days, aids the escape of the lochial discharge and the expulsion of any clots from the uterus.

The most important safeguards consist in the use of those antiseptic precautions during labour and the puerperal state which have been already described (see pp. 205, 282), especially those which are designed to prevent the introduction of any septic microbes into the genital canal.

Direct precautions should also be taken against any possible conveyance of contagion from any virulent source. No nurse should be allowed to be in attendance who has recently attended any case of zymotic disease, puerperal septicæmia, erysipelas, or even any doubtful case of pyrexia after delivery. All unnecessary visitors should be excluded from the lying-in room during the first week, especially any who are likely to have been in contact with any zymotic or puerperal contagion.

In family practice it is impossible, as a rule, for the practitioner to give up midwifery practice whenever he has cases of erysipelas or zymotic disease, or suppurating wounds, under his charge. That contagion is but rarely carried appears to be proved by the comparative rarity of actual scarlatina and erysipelas after delivery in proportion to the whole number of cases of severe puerperal pyrexia (see pp. 779, 784), especially when it is remembered that contagion may be received in many other ways besides that of conveyance by the accoucheur. All medical men should, however, take the most careful antiseptic precautions after visiting cases of any zymotic disease before attending a labour or visiting puerperal patients. Not only should hands be washed in some effective antiseptic solution, such as perchloride of mercury (1 in 1,000), but clothes should be changed, and the longest possible interval allowed for disinfection by fresh air.

It should be remembered that, next to puerperal fever itself, the most dangerous source of infection is phlegmonous erysipelas with a discharging or suppurating wound. Any practitioner attending to such a wound would do well to avoid midwifery practice, if possible.

It is a still more important question what precautions are necessary when a medical man has a case of puerperal pyrexia of any form under his charge, and whether it is his duty, under these circumstances, to give up midwifery practice. It is as undesirable to impose restrictions which are not necessary as to omit any which are really called for. A practitioner may be tempted to omit local treatment, which is of importance for the recovery of his patient, if he believes that his undertaking it renders it necessary for him to give up the greater part of his practice. Again, under similar circumstances, he may be reluctant to admit to his own mind, when diagnosis is doubtful, that any given case of puerperal pyrexia is of septicæmic character, and liable to become the source of infection.

Puerperal septicæmia does, however, appear to be the most dangerous source of contagion of all, as is proved by those unfortunate instances in which a practitioner has a series of severe or fatal cases in his practice, terminated only by his giving up midwifery for a considerable time. The utmost precaution is therefore necessary. When contagion has been conveyed by the accoucheur, it has frequently happened that the victims have been women delivered within two or three days after the one who was the source of the contagion, and the mischief has thus been done before the physician had become aware that the disease was of a nature requiring special precaution. It would be impossible for every medical man to give up midwifery practice whenever a patient had a rise of temperature after delivery. The first and most essential requisite, therefore, is to regard all cases of puerperal pyrexia, even of the slightest kinds, as suspicious, and to adopt the most scrupulous antiseptic precautions in attending them.

It is above all important to preserve the clothes, and especially the coat, from becoming contaminated. The hands may probably be made safe by the thorough use of antiseptics, but the clothes cannot be so unless they are disinfected by heat. Fumigation may perhaps destroy germs conveyed in the form of dust and settling on the surface, but cannot be relied upon if there has been closer contact with infecting material; or if blood or discharge has soaked into the cloth. Even if the clothes are changed, it is easy to understand that, in the very act of changing, contagion may be conveyed by the hands from one suit to another. When physicians have given up midwifery for several weeks and yet have had a recurrence of septicæmia on returning to it, it is probable that, in most cases, the contagion has lingered in clothes. It is obvious that gloves especially, if once infected, would readily again convey contagion to the hands. Sometimes, indeed, there may have been something peculiar to the individual, as in the case of those who have themselves any ailment associated with a purulent discharge. It has been supposed that the poison may be absorbed into the system and exhaled by the skin or lungs, but this cannot be regarded as proved. Now that organisms are recognised as being the cause of all true septicæmia, it appears highly improbable that the septic organisms could multiply or even exist in a healthy person and cause no symptoms.

In any case, therefore, of puerperal pyrexia, even if regarded as not serious, the physician should keep his clothes from contact with the patient or the bed-clothes. If he makes any vaginal examination he should take off his coat and roll up his shirt sleeve. After touching the patient, or anything connected with her, he should constantly bear in mind that his hand is contaminated, and avoid touching his own clothes, bag, or instruments with it until it has been disinfected. A thermometer or stethoscope should be disinfected with equal care. After disinfecting his hands he should avoid even shaking hands with the patient on leaving. According to Koch's researches,* the usual mode of fumigating with sulphur is useless for a room, and still more so for clothes. The most effectual mode of fumigation is with chlorine, but as much as 15 lbs. of chloride of lime, and 22 lbs. of hydrochloric acid, are required for each 1,000 cubic feet, and the room should also be filled with steam. Even this cannot be relied upon to sterilise clothes.

When a case of puerperal pyrexia is likely to be specially contagious, it is desirable that the attendant should give up midwifery practice for a time. Much has yet to be learnt about the differences in contagious character of different forms of the disease. But it appears to be clearly established, that the most contagious are very severe or fatal forms of it (see p. 787), and also those which are themselves derived from conveyed contagion. My own belief is, that antiseptic precautions carried out as described above are an adequate security.* But the fact remains, that contagion is sometimes conveyed. There is also another consideration to be taken into account. If it is known that a practitioner has lost a patient after delivery, and any other of his patients suffers from pyrexia, he is likely to be accused of carrying contagion, even though there may be, in reality, no connection between the two cases. Hence if a practitioner has a fatal case of puerperal septicæmia, or one likely to prove fatal, he will do wisely to give up midwifery practice up to at least a week after the cessation of attendance. A bath should be taken before he again attends labour, the clothes disinfected, if possible, by steam, and a different suit worn. If there is reason to think that contagion has actually been conveyed to any other patient, it is obvious that the antiseptic precautions taken have not proved adequate. It is then imperative to give up midwifery practice, and, in this case, it is well to make the quarantine longer—as much as two or three weeks. Midwives should be advised to be still more cautious about attending other labours if they have had one case of pyrexia, since they cannot generally be trusted to use such enlightened skill in their antiseptic precautions.

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* Microparasites in Diseases. New Sydenham Soc., 1886.

Prophylaxis in lying-in hospitals.—Until the last few years the mortality due to puerperal septicæmia in lying-in hospitals has been so great, that many authorities have considered that such institutions are an injury, rather than an advantage, to the community. Not only have epidemics of septicæmia arisen from time to time in the hospitals and compelled their temporary closure, but sporadic cases have been sufficiently numerous to keep the mortality always high. While in such institutions as the out-door lying-in charities of London hospitals, and the Royal Maternity Charity, the total maternal mortality generally does not exceed one-half per cent., in lying-in hospitals, apart from any epidemic, the mortality had almost always exceeded one per cent., and often reached or exceeded two per cent. About the beginning of the present century, indeed, great improvement appeared to have been attained, and modern science was much congratulated thereupon. But the course of affairs afterwards proved to be retrograde. Thus, at the Rotunda Hospital, Dublin, always reputed to be one of the most healthy of lying-in hospitals, between 1826 and 1833, the mortality was 9 per 1,000. But between 1847 and 1854 it had risen to 13 per 1,000, and between 1858 and 1875 to 22 per 1,000, although the number of patients delivered had diminished by one-half, and therefore the hospital was much less crowded than before. Some years previous to 1868, mortality had been much higher still. Similarly, at the British Lying-in Hospital, the deaths per 1,000, which for the decennial periods from 1749 to 1800 had varied from 16·5 to 23·6, fell in the decennium 1789–1800 to 3·2. At the City of London Lying-in Hospital the mortality in the decennium 1800–1810 was reduced to 4·3 per 1,000. But in 1865–1875 the mortality of the British Lying-in Hospital was again as high as 19·4 per 1,000, and that of the City of London Lying-in Hospital as 14·3 per 1,000. It therefore appeared that it was better for a woman to be delivered in the dirtiest and most poverty-stricken home than in the most spacious and best-managed lying-in hospital.

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* In the following case, which occurred in my experience, the efficacy of antiseptics was severely tested. I was called upon to perform version in a case of placenta prævia where vaginal plugs had been left too long in place, and the retained clots had decomposed. The patient was already in a condition of acute septicæmia, with a temperature of 105° F. The smell was so offensive that it penetrated the epithelium and could not be permanently removed from the hand and arm by a strong solution of carbolic acid, reappearing again each time after a minute or two. It so happened that within an hour after this operation I was obliged to operate in Guy's Hospital in a case of contracted pelvis, the operation having proved too difficult for the Obstetric Resident. Extraction had to be effected with great difficulty through a pelvic outlet measuring not more than two inches transversely. The first patient died after developing symptoms of pyæmia; the second recovered without more disturbance than was to be expected after so severe an operation.

The transformation, by which lying-in hospitals, not only in Britain but on the Continent, have now been transformed from the most dangerous into the safest places for a lying-in woman, appears to depend mainly upon the use of perchloride of mercury as an antiseptic. Taking the General Lying-in Hospital as an example, the death-rate has been reduced from 10 or more to less than 4 per 1,000; the death-rate from septicæmia or pelvic inflammation to 1·5 per 1,000; and cases of septic pyrexia, including slight and transient ones, from 40·0 to 2·5 per cent.

These results have followed from the following use of antiseptic agents. Perchloride of mercury, 1 in 1,000, is used to disinfect hands and non-metallic instruments by everyone who touches the patients. A douche is employed before labour, but this has varied in its character without affecting the results. A douche of perchloride of mercury, 1 in 2,000 is used after labour. The same antiseptic is used for washing and douching the patient regularly throughout the puerpery; for the first three days, of a strength of 1 in 2,000, afterwards 1 in 4,000. Horsehair mattresses are employed, and are disinfected by heat only when an unfavourable case has occurred. A separate irrigator is provided for each bed, having a vaginal tube of glass.

It is possible that some of the modern non-poisonous antiseptics may prove as efficacious as mercury, but they have not yet been sub-

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jected to so prolonged a trial. Lysol may be used of a strength of 1 in 200 for vaginal douches, chinosol 1 in 2,000, creolin 1 in 100. It appears to be safest to retain the mercurial solution for disinfection of hands. At the New York Lying-in Hospital routine douches have been abandoned, without impairment of results. But the vulva is kept covered by antiseptic pads soaked in creolin, 1 in 100, covered with oiled muslin, and changed every six hours, or whenever the patient passes urine or fæces. At the Rotunda Hospital, Dublin, routine douches are also disused and the results remain excellent.

Treatment.—*Local treatment.*—The first question to be considered is that of local treatment, to prevent, if possible, the entrance of any more septic germs or poisonous material into the circulation or tissues. In any case of pyrexia vaginal irrigation should be adopted, if it has not previously been carried out. The irrigation should be more frequent than is necessary in a normal case, and should be repeated every four or every six hours. One of the most efficacious antiseptics should be used, such as perchloride or iodide of mercury (1 in 2,000). If the patient should be suffering from diarrhœa, chinosol, 1 in 2,000, or creolin, 1 in 100, may be used instead of the mercurial solution. If there has been any offensive discharge, a pessary containing 15 or 20 grains of iodoform may be introduced into the vagina after each irrigation.*

N13 Intra-uterine irrigation is a mode of treatment requiring considerable caution, but, in certain cases, it is of very great value. Its indiscriminate use after all cases of labour has been found to be rather injurious than beneficial, and to increase rather than to diminish the number of cases of septicæmia. This is probably due to some morbid material being carried by the irrigating tube from the vagina into the uterus, or to abrasions of the mucous membrane produced by its use. Irrigation is most urgently called for when pyrexia follows retention of a portion of placenta or clots, adhesion of the placenta, the delivery of a decomposed fœtus, prolonged operations within the uterus, or injection of an iron solution into the uterus, or when there is an offensive discharge which does not yield to vaginal irrigation. It is not required in every case of elevation of temperature after delivery, for such elevation may prove to be transient. In any case, however, in which, within the first few days after delivery, pyrexia is accompanied by marked rigors, in which pulse and temperature rise to a high point, or in which there are other signs of septic disturbance, such as tenderness of the uterus, and arrest of its involution, it is desirable to try the effect of washing out the uterus. Even if there is septicæmia due to conveyed contagion, the organisms probably multiply in the genital tract before gaining access to the tissues, and it is therefore important to destroy them, if possible, throughout the whole of that tract. If, indeed, the organisms are specially virulent, those already in the blood or tissues may multiply till a fatal result is produced. But it is impossible to be sure, at the outset, what is the virulence of the poison, and it may always be hoped that the vitality of the body may triumph over the micrococci, if no more are allowed to gain access. Uterine irrigation is specially called for if there is suppression of the lochia within the first few days. For the residue of the decidua, which is generally washed away in the lochial discharge, then remains within the uterus, and is generally seen, at an autopsy, to have a ragged sloughy appearance.

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* At Vienna iodoform rods are used according to the following formula :—iodoform gr. 100 ; gum arabic, glycerine, and starch, each 10 grains. One of these is introduced into the uterine cavity after every difficult labour.

A solution of perchloride or iodide of mercury is the most powerful antiseptic, and may be used in general of a strength of 1 in 4,000. On the first occasion a small quantity may be used of a strength of 1 in 1,000, and then washed away with the weaker solution. The best tube for irrigating the uterus is Budin's double-action catheter (see Fig. 153, p. 416) of glass or celluloid; and care should be taken that the end of the tube is passed up quite to the fundus. This can generally be done most easily with the patient in the lateral position.

Curetting the interior of the uterus is a plan which sometimes produces striking benefit, but which is also capable of doing considerable harm. If new paths for absorption are opened, and the whole of the material in which septic organisms are multiplying is not removed, it promotes rather than cures septicæmia. If the measure is adopted at a stage at which septic inflammation has spread to the peritoneum or elsewhere beyond the endometrium, it cannot cure, and only increases inflammation by its traumatic effect.

The stage at which it may be useful is within 48 hours of the commencement of pyrexia, and while local symptoms of inflammation are limited to the uterus. It is chiefly indicated when there is a suspicion that some placenta or clots may be retained within the uterus, especially if the discharge is offensive. If intra-uterine irrigation has been tried for 24 hours without relieving the symptoms, curetting may then be undertaken.

An anæsthetic should be administered and the finger passed up to explore the cavity of the uterus, and remove any loose pieces which it can detect. It is not generally necessary to employ instrumental dilatation of the cervix previously. The best form of curette is a blunt irrigating curette of rather large size attached to

an irrigator. By means of this a stream of hot antiseptic solution at 115° is poured through the stem of the instrument during the operation, and tends to check hæmorrhage as well to wash away *débris*. The placental site should be specially scraped, but the rest of the endometrium may also be treated, especially if it feels soft and shreddy. If any considerable mass of placental tissue is found retained, it may be sufficient to clear this out with the finger, and wash out the uterus, without using the curette. Higginson's syringe
B. should not be used, since it is apt to pump in air, and also allows reflux into the tube. An irrigator * is the safest means. In the absence of this, it is best to use an ordinary large syringe with well-fitting piston. The vagina should first be washed out, less anything

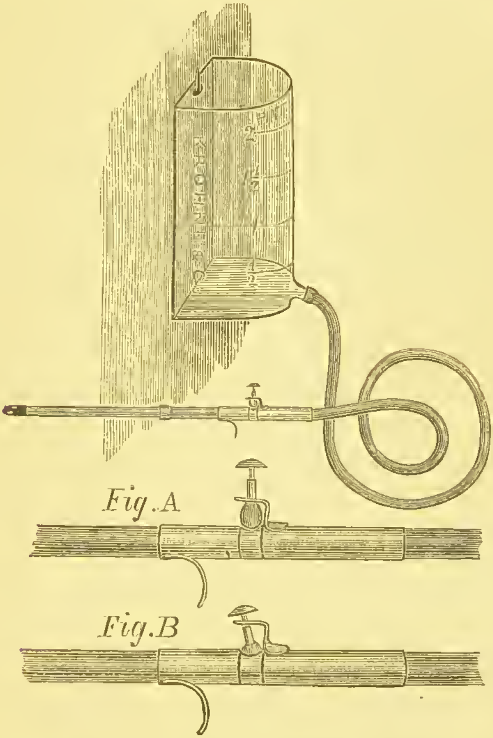

Fig. 271.—Irrigator with glass reservoir and pressure stopcock. Fig. A shows the stopcock open; Fig. B, the same closed. The stopcock is closed by pressure downward and forward upon the button.

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* An irrigator is made by Messrs. Krohne and Sesemann in which the reservoir and vaginal tube are of glass, and the ordinary stopcock is replaced by a pressure stopcock, so that the calibre is unimpeded when the stopcock is open, and the elastic tubing can readily be replaced by a new piece. (Fig. 271.)

septic should be carried by the tube into the uterus. The tube should then be filled before introduction, and in the absence of a stopcock, a clip should be placed at the lower end of the elastic portion till it has been introduced. The piston should not be pushed down quite to the bottom to avoid injecting air; and care should be taken that there is plenty of room in the cervix for the fluid to escape. If the syringe requires refilling an assistant meanwhile pinches the top of the elastic tubing between his finger and thumb to prevent entry of air. Care should be taken not to allow an excess of fluid to remain in the uterus or vagina.

Considerable nervous disturbance is sometimes produced by washing out the uterus, and I have seen it cause an epileptiform convulsion, the ultimate effect, however, being favourable. If improvement appears to follow the irrigation, or if much shreddy material is washed away, it may be repeated once or twice a day according to circumstances. If on the other hand nothing is washed away, if there is no offensive discharge, and no improvement follows, it is not generally desirable to repeat it. Sometimes, when the case is mainly one of septic intoxication alone, a very rapid and marked result follows. As might be expected, the results are most favourable when the irrigation is practised at the outset of the pyrexia. It is rarely of any use when as much as a week has elapsed since delivery, unless there is evidence of retention of placenta or clots within the uterus. If there is evidence that the source of mischief is within the uterus, as when the placenta has been adherent, suppositories or rods (see p. 808) containing iodoform may be passed into the uterus after each irrigation.

If there is any reason to believe that any portion of placenta has been retained within the uterus, as, for instance, when excessive or recurrent hæmorrhage has preceded the pyrexia, the cavity of the uterus should be explored by the finger, previously disinfected. If anything is found there, the cavity should be evacuated in the manner recommended for the treatment of recurrent hæmorrhage after delivery (see p. 772). The same treatment should be carried out if, on making a vaginal examination, or on passing up the tube for uterine irrigation, any mass within the uterus is detected by the finger. With the exception of such necessary local treatment, all vaginal examinations and manipulation of the abdomen should be made as sparingly as possible, so as to secure the greatest amount of rest for inflamed tissues.

The vulva should be inspected in any case of serious puerperal pyrexia. If any "puerperal ulcers" are discovered, they should be painted over with equal parts of tinct. ferri perchlor. and tinct. iodi, or with solution of nitrate of silver (gr. xx. ad ℥i.), or a solution of carbolic acid in glycerine (gr. lx. ad ℥i.) If there is any diphtheritic or pseudo-diphtheritic deposit upon the ulcers, the applications should be repeated until it disappears.

The peritonitis may be treated locally by hot fomentations, covered by oiled silk, or by cold. Turpentine fomentations at the outset sometimes give comfort. For the relief of tympanitic distension of the abdomen, when this is very extreme, the effect of passing a long rectal tube, and of giving a turpentine enema, may be tried.

Diet.—Much depends upon supporting the strength by liquid nourishment given in small quantities at short intervals. As a rule the interval should not be more than two hours. The chief reliance should be placed upon milk, but yolks of eggs beaten up with milk, beef-tea, and meat jelly may also be given. Brand's essence of meat is often retained when other food is vomited. If milk is vomited in curds, barley-water should be mixed with it. If there is diarrhœa, beef-tea should be avoided, and the milk should be given with lime-water. Alcohol is of use, as tending to lower the temperature, and having also probably, in some degree, an antiseptic influence. ʒii Two or three teaspoonfuls of brandy may be given every hour, beaten up with egg, and an equal quantity of water. Iced champagne is sometimes found to relieve vomiting. In severe cases, when the pulse becomes very rapid and feeble, the quantity of brandy may be increased up to eight or twelve ounces in the twenty-four hours. If there is so much vomiting as to prevent the retention of a sufficient amount of nourishment, nutrient enemata should be given. The formula given at p. 318 may be used, with the addition of an ounce of brandy. If there is diarrhœa, twenty minims of tincture of opium may be added. Forty grains of oxide of bismuth may also be added.

Medicinal treatment.—The drug most to be relied upon, both as an antipyretic and antiseptic, is quinia. A ten-grain dose may be given at the outset, when pyrexia is high, and then five grains every three or four hours. When the fever is continuous, and is not contolled by this means, a dose of twenty grains given twice a day is sometimes more effectual. Large doses of quinia are often better tolerated when given, not in an acid solution, but as a simple powder in water or in a mucilaginous mixture with 15 grains of subnitrate of bismuth and 5 grains of bicarbonate of soda.

Other antipyretics, such as salicylate of soda or antipyrin, may be tried if quinia fails or is not tolerated. Antiseptics, such as sulphocarbolate of soda and sulphite of soda are also sometimes used, but have not proved on the whole to give better results than quinia. They may be given, alternately with quinia, if the quantity of quinia has to be diminished on account of cinchonism. In cases in which quinia has failed, Warburg's tincture, in which quinia is combined with a large number of aromatic substances, has sometimes been found useful. It is given in two or more successive doses of half an ounce, undiluted, at two or three hours' interval. In adynamic conditions, when there is great tympanites, oil of turpentine (♏ xv.–xx.), given on sugar, may be of use. All these drugs should be discontinued, if they either produce vomiting, or destroy the appetite; and reliance for an antipyretic effect can then only be placed on cold applications.

When there is peritonitis, opium or morphia should be given in sufficient quantity to control the pain. When pain is severe, large quantities are often well tolerated, and appear to be beneficial. A subcutaneous injection of a quarter or a third of a grain of acetate of morphia may be given at the outset, and then some Battley's liquor opii sedativus may be given with the quinia. In the case of vomiting, the sedative may be given by the rectum or subcutaneously. In prolonged cases of fever, and those which assume the pyæmic form, the tincture of perchloride of iron, in addition to, or in substitution for, the quinia, is often of great value.

The result of giving purgatives as evacuants has been highly spoken of by some authorities, but there is a risk of setting up diarrhœa, which is always an unfavourable symptom. If there is constipation at the outset of pyrexia, and no very acute peritonitis, or sign of severe septic affection, three or four grains of calomel may be given. This is often followed by a fall of temperature. Diarrhœa should not be stopped too quickly, if moderate in amount, since some of the poison may be carried off in the evacuations. If necessary, opium may be given by the mouth or rectum. Tincture of perchloride of iron is of use in checking diarrhœa, if tolerated by the stomach.

Vascular depressants, such as tincture of aconite in doses of one minim, given at first every half-hour, or tinct. veratri viridis, in five-minim doses, are recommended by some authorities. If given at all, they require very careful watching. They should be used only at the outset, and should be avoided in any asthenic form of disease.

Anti-streptococcic serum.—A modern method of treatment, the value of which has not yet been fully tested, but which may prove to be of more value than drugs, is the subcutaneous injection of the anti-streptococcic serum. To get the full effect, it appears to be necessary to inject as much as 10 c.c. at a time, and to repeat the injections as much as twice a day. A first dose may be given of 20 c.c. In some cases, this treatment, when employed early enough, has been quickly followed by improvement, and recovery has resulted. In others it appears to cause temporary improvement, and to pro-

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long the course of the disease, although the fatal result is not averted. When there is purulent peritonitis, or any considerable formation of pus elsewhere, it can hardly be expected that any antitoxin circulating in the blood can check the growth of the micrococci. Bacteriological examination of the discharge is desirable, as a guide as to whether continued use of the serum is advisable, since it is of no avail if the infection is not due to streptococci.

Refrigeration.—If the temperature rises to a very high degree, such as 105°, and is not brought down by antipyretic medicines such as quinine, benefit is sometimes found from direct application of cold. Baths or wet packing have been used, but the disturbance to the patient which these involve is a serious disadvantage in peritonitis. The simplest mode of reducing temperature is the application over the head, either of Thornton's ice-water cap, made of india-rubber tubing, or of Leiter's temperature regulator, made of metal tubing, through either of which a stream of ice-cold water is kept running from a reservoir elevated above the bed, the rapidity of the stream being regulated by a tap. This application of cold to the head is generally found to affect appreciably the temperature of the whole body. If its effect proves insufficient, the body may be sponged occasionally with water at a temperature between 70° and 80° F. A Leiter's temperature regulator may also be applied over the abdomen if desired. It is most useful at the outset of the disease, when there is tenderness of the uterus, with a rise of temperature. An ice-bag may be used in the absence of a coil. A thin garment should be interposed between the coil and ice-bag and the skin.

Runge,* of Dorpat, urges the treatment of puerperal septicæmia by large quantities of wine and brandy, combined with the use of baths, instead of quinine or other antipyretic. From one to three baths are given in the day, and their duration is from five to ten minutes. The temperature is about 85° F. at first, and is lowered to about 80° by the addition of cold water. Severe abdominal pain and tenderness, and violent vomiting, are contraindications to the baths; and they are, therefore, not available in the worst cases. A tendency to somnolence or delirium, high temperature, and abdominal distension, without extreme tenderness, are the strongest indications for them.

In America, Kibbie's fever-cot, made of cotton netting, with india-rubber cloth beneath, is used for the same purpose, and has the advantage of involving less disturbance than baths. Affusion of water at 85° or 80° to the trunk only is practised every hour until the temperature is reduced.

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* Volkmann's Sammlung. No. 287, 1886.

Operative treatment.—If there is reason to believe that the origin of the disease is a pyosalpinx of old standing, it affords a chance of cure to perform abdominal section, remove the tube, wash out the peritoneal cavity with warm water, a weak solution of iodine (tinct. iodi ʒi. ad aq. O i.), or a saturated cold solution of boric acid raised to a temperature of 100° by addition of hot water, and place a Keith's glass drainage tube, reaching to the bottom of the pouch of Douglas, as after ovariotomy. The same treatment has been adopted in other cases of puerperal peritonitis, and a very few successful results have been reported. In most cases, however, it affords only a very forlorn hope, although, in purulent peritonitis, it may be the only possible chance. For, in general, there is enough septic inflammation outside the peritoneal cavity to prove fatal. When there is evidence of fluid in the peritoneal cavity, and the patient appears to be too ill to withstand the shock of irrigation of the abdomen, it might be preferable merely to make a small incision, insert a Keith's tube to the bottom of the pouch of Douglas, and suck out the fluid through it.

A more thorough operation than drainage of the peritoneal cavity would be removal of the uterus with as much as possible of the broad ligaments, and drainage of the pelvis through the vagina. But, by the time that such a proceeding is indicated, the patient is generally too weak to undergo so considerable an operation. If an exploratory abdominal section is performed and the tubes are found diseased, and it is thought that there is septic inflammation also of the uterus, it may be the best plan to remove the uterus with the appendages, otherwise vaginal hysterectomy would probably afford a somewhat better hope, as causing less shock. In such a case, it would be preferable to use clamp forceps, not ligatures, to secure the broad ligaments, that the operation may be shortened as much as possible, and the cellular tissue drained the better, when the clamps are removed. The peritoneum should be left open, with a drain of iodoform gauze in the vagina.

Treatment of pelvic cellulitis and pelvic peritonitis.—In these conditions the treatment has to be directed chiefly to the local affections and to the consequent pyrexia, not to any general septicæmia. If the disease comes on with high fever within a week after delivery, quinia should be given in full doses in the manner already described. If it commences insidiously, and is observed only at a later period, quinia may be given in more moderate doses. Opiates should be given in sufficient quantity to keep the pain in check. The requirement for them will be mostly in proportion to the degree in which the peritoneum participates in the inflammation. In mild cases, suppositories containing half a grain of hydrochlorate of morphia may be introduced per rectum from time to time by the nurse, whenever great complaint of pain is made. Linseed poultices should be kept constantly applied over the lower part of the abdomen, so long as there is pain and high temperature. Glycerine of belladonna or tincture of opium may be spread over the skin beneath. If it is desired at this stage to try the effect of an absorbent, the skin under the poultice may be smeared with equal parts of unguentum hydrargyri and unguentum belladonnæ.

In America the application of cold instead of heat is much used, but it is doubtful whether cold applied to the skin really diminishes the temperature in the deep parts of the pelvis, beyond that extent to which it may lower the general temperature. As a rule, the warm application gives more comfort to the patient. If cold is employed, a coil of Leiter's temperature regulator over the abdomen is the most convenient mode for applying it. The time for applying cold is while it is hoped that suppuration may be averted. If suppuration has commenced, poultices hasten the pointing of the abscess, and do most to relieve pain.

An essential part of the treatment is complete and prolonged rest. A late outbreak of acute symptoms is often due to the earlier stage having been overlooked, and the patient getting up and returning to work prematurely. The patient should remain in bed until the N-B pain, tenderness, and pyrexia have subsided for some considerable time, and the exudation is, in great part, absorbed. Caution about any over-exertion or exposure to cold is necessary for weeks or months longer. If there is persistent local pain long after all fever has subsided counter-irritation to the skin over the painful spot may be employed. Liniment of iodine may be painted over it daily until the skin becomes sore.

Irrigation or syringing with hot water at a temperature of from 110° to 115° F. appears to tend to reduce the inflammation and hasten the absorption of the exudation by stimulating the lymphatics. This may be commenced as soon as it can be carried out without too much disturbing the patient, and employed two or three times a day until the exudation has been in considerable part absorbed and the patient is able to get up. Absorbent drugs are not of so much avail as promoting the general nutrition and vigour of the patient by good food and tonics. But, in the later stage, after the subsidence of fever, the liquor hydrargyri perchloridi may be given in eighty-minim doses three times a day. This appears to be preferable, in general, to iodide of potassium, as being rather tonic than depressant. It may be combined with quinine, cinchona, or with tinct. ferri perchloridi. Iodide of potassium, in five-grain doses, may also be combined with it.

Treatment of pelvic abscess.—As soon as an abscess points externally it should be opened antiseptically. Reddening of the skin will be an indication that there is no risk of opening the peritoneal cavity. If there is doubt as to the depth at which the pus lies, a hypodermic syringe or small aspirator needle may be used to explore in the first instance. The incision may be made after disinfection of the skin with perchloride of mercury (1 in 1000), and a drainage tube introduced according to Lister's method, the end of the tube being cut off level with the skin, and secured by two loops of carbolised silk, passed through the end of the tube and laid flat upon the skin beneath the gauze dressings. If the pus is not quite superficial, Hilton's method of opening deep abscesses should be employed. After an incision through the skin, a director is pushed into the abscess. By its means the points of a pair of dressing forceps are guided into the cavity. The forceps are then opened, and withdrawn, so as to enlarge the opening sufficiently. If fluctuation can be felt, but the skin is not reddened, and it is doubtful whether the peritoneum intervenes, it is better to make an incision down upon the abscess, layer by layer, as in abdominal section. If free peritoneal cavity is opened, it may be possible to ascertain a spot where the abscess can be reached, clear of the peritoneum; and then the pus may be evacuated there, the primary incision having first been closed. If an abscess has spontaneously opened or has been opened externally, and the sinus does not close, but pus continues to be poured out from a large cavity, a large drainage tube should be introduced to the full depth of the cavity. The cavity may be washed out daily by means of a funnel with a solution of iodine (Tr. iodi ʒii. ad Aq. O i.), chinosol 1 in 2000, or sulphurous acid (Acid. sulphurosi i.–ii. ℥. ad Aq. O i.). Such a failure to close is more likely in the case of an abscess due to peritonitis than in the ordinary suppuration of pelvic cellulitis, especially when the opening is high up in the abdomen, as for instance at or near the umbilicus. Carefully adjusted pressure by pads of cotton-wool may assist in causing the abscess to close. In rare cases, when other means fail, if the abscess cavity is found to descend close to the vagina, it may be desirable to make a counter-opening at its lowest point by cutting from the vagina upon the point of a probe passed into the abscess. The vaginal opening should then be enlarged, the cavity stuffed with iodoform gauze from the vagina, and the upper opening allowed to close first.

If a fluctuating swelling, due to the pointing of an abscess, can be felt from the vagina, the presence of pus should first be verified by an aspirator needle, and the abscess then opened by Hilton's method, as already described. The most favourable point for opening is the posterior vaginal fornix. A drainage tube may be introduced, the most suitable form of tube for the purpose being a self-retaining elastic catheter. If the constitutional symptoms indicate suppuration, and a boggy feeling only can be detected in the swelling, but no distinct fluctuation, the aspirator may be used to search for pus.

PUERPERAL TETANUS.

Puerperal tetanus is extremely rare in this country. No instance of it occurred in 46,089 deliveries in the Guy's Hospital Lying-in Charity, and I have met with it only once. According to modern doctrine it depends upon infection by the bacillus of tetanus, and thus is really a special form of septicæmia. When it occurs in puerperal women, it is probable that the microbe has been introduced into the genital canal. It resembles surgical tetanus in the fact that an important exciting cause is exposure to cold, especially in hot climates, where the microbe of tetanus is comparatively common. Tetanus has sometimes been observed after full-term delivery, but more frequently after abortion, especially if an adherent placenta has been separated from the uterus.

The symptoms, prognosis, and treatment are similar to those of tetanus in general. Sir James Simpson collected the records of 27 cases, of which 22 were fatal. Of late hysterectomy has been performed with the hope of removing the focus of the disease, but not hitherto with success.

The new-born infant is also liable to tetanus, especially in hot countries, the seat of absorption being the umbilicus, on the falling off of the funis.

CHAPTER XL.

PHLEGMASIA DOLENS, THROMBOSIS, EMBOLISM, SUDDEN DEATH.

PHLEGMASIA DOLENS, OR PERIPHERAL VENOUS THROMBOSIS.

THE term "phlegmasia dolens" or "phlegmasia alba dolens" is applied to a swelling of one or both legs, characterised by pain, tension of the skin, brawny hardness, absence of pitting on pressure, and a shining whiteness of the surface. Much controversy has taken place as to its true pathology. In former days it was fancifully ascribed to a metastasis of the milk. From this theory, and from the white appearance of the skin, was derived the popular term of "milk-leg." By different authorities it has been regarded as inflammation or obstruction of the lymphatics, as general inflammation of all the tissues of the limb, or as phlebitis.

It is now recognised that the most constant anatomical condition is thrombosis of the veins; and that phlebitis, if it occurs, is generally secondary, either to the thrombosis or to inflammation of surrounding cellular tissue. There must, however, be something more than obstruction of the veins to account for the brawny tension of the affected limb, the tissues of which are filled with coagulable lymph, not with ordinary serum. The condition is totally different from the common œdema which is produced by pressure on veins, or even by thrombosis of a vein under different circumstances. This can only be accounted for in one of two ways: either that obstruction of the lymphatics as well as of the veins is an essential part of the disease, or that there is some toxæmic condition of the blood, in consequence of which the fluid poured out is irritating to the tissues and sets up a kind of quasi-inflammation, leading to the production of coagulable lymph. Probably both these conditions, and especially lymphatic obstruction, actually play a part in the causation. The lymphatic obstruction cannot, however, be so readily demonstrated anatomically as the venous thrombosis. It was especially contended by Tilbury Fox[*] that the lymphatic obstruction is the most essential part of the disease, and that phlegmasia dolens may exist even without any thrombus in the veins.

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[*] Obst. Trans., 1862.

Causation.—There is strong reason for believing that the presence of some septic material in the blood generally has an influence in the production of the coagulation. This is shown by the fact that phlegmasia dolens does sometimes occur apart from pregnancy or the puerperal state, and that this happens in cases where there is some source for septic absorption. It has been especially observed when there is ulcerated cancer of some internal part, such as the cervix uteri, but has sometimes occurred in a late stage of phthisis. The following case, recorded by Tyler Smith,* also shows that phlegmasia dolens may sometimes have its origin in septic contagion. A practitioner had been in close attendance upon a patient dying of erysipelatous sore-throat with sloughing, and was himself affected by sore-throat. Under these circumstances he attended, within the space of twenty-four hours, three ladies in their confinements. All these ladies were attacked by phlegmasia dolens. Phlegmasia dolens might therefore, like parametritis, have been included in the chapter on puerperal fevers. It has been thought more convenient to describe it separately, because it generally arises at a later stage than the forms of fever there described, and is only rarely associated with general septic infection. It resembles parametritis, however, in the fact that, although it probably should be included within the definition of septic diseases, it has a generally favourable prognosis. Fatal cases being rare, it has not been determined whether any septic element which is present is a chemical poison only, or whether microbes are present in the thrombus. But if there are any, they must be of a comparatively innocuous kind, since the thrombus very rarely breaks down and gives rise to general vascular pyæmia. In the rare cases in which local abscess or pyæmia does follow, micrococci are doubtless present.

The impoverished blood of the pregnant woman is already prone to clot, as is shown by the tendency to thrombosis in varicose veins even during pregnancy. This tendency is further increased if there has been any undue hæmorrhage after delivery. The local conditions also favour thrombosis. The veins have been distended in consequence of the abdominal pressure in pregnancy, and the current in them is slow while the woman is lying quiet in the puerperal period. Moreover, there are always thrombi in the mouths of the uterine veins. From these thrombosis may easily extend deeper into the uterus, and thence into the veins of the broad ligaments

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* Manual of Obstetrics, p. 539.

If it proceeds no further than this it gives no sign of its existence. But from the broad ligament thrombosis may reach the iliac veins, and spread downward to the femoral veins. It has long been observed that women who have suffered from hæmorrhage are most prone to phlegmasia dolens. Any febrile condition also increases the fibrin in the blood, and thereby the tendency to thrombosis.

Symptoms and course.—The commencement of symptoms is rarely within the first week after delivery; more frequently it is in the second week, and still more frequently in the third. Sometimes, but not always, there are preliminary symptoms of malaise with coated tongue and slight pyrexia. The first characteristic symptom is that of acute pain in the leg. The locality of this depends upon the course of the local affection. More frequently this commences in the thigh, near the femoral vessels, and spreads downward. Less frequently, it begins in the calf of the leg, or near the ankle, and extends upward and downward. Exceptionally the swelling remains limited to the upper part of the thigh.

The left leg is affected more frequently than the right, probably because the venous circulation of the left leg is more apt to be impeded from the presence of the rectum and sigmoid flexure on the left side. Not unfrequently the other leg is affected afterwards, generally after an interval of about a week. Exceptionally the attack is preceded by pelvic cellulitis on the affected side. In this case, the thrombosis is probably secondary to inflammation of the cellular tissue surrounding the iliac or femoral veins.

The onset of pain is accompanied by a rise of pulse and temperature, the temperature generally reaching 101° or 102°. Sometimes there are also initial rigors. Swelling follows quickly upon the pain. At first the swelling may pit on pressure, as it does also when subsiding. It gradually increases for two or three days, and when it has reached its height, has the characters already described. The white tense surface may be variegated by knots of purple superficial veins. If the skin is pricked, the fluid which exudes is not thin serum, but coagulable lymph. Special swelling and tenderness may be felt along the course of the affected veins, especially at the onset or decline of the affection. When the tension is very great they are not so easy to detect. Motion of the leg is prevented on account of the pain and pressure of the swelling on the muscles. After from seven to ten days, the pyrexia generally subsides, and the swelling begins to be less tense, and to allow pitting on pressure. It does not completely disappear for several weeks, generally as much as five or six, and sometimes the tendency to swelling remains for many months afterwards. Occasionally, during the early stage, there are renewed attacks of pyrexia, with extension of the thrombosis to fresh veins. In other cases the disease runs a course similar to that of thrombosis of the femoral vein, apart from the puerperal state. The swelling remains moderate in degree, pits on pressure throughout, and never becomes tense and hard.

In rare cases the arm becomes affected by phlegmasia dolens in the same way as the leg. Phlegmasia dolens of the arm alone has chiefly been observed apart from the puerperal state. But in some puerperal patients the arms become affected as well as the legs, and thrombosis may occur in other situations also, as in the neck. These multiple thromboses are generally the sequelæ of some general septic infection, and are of a grave character.

Pathological anatomy.—The veins most frequently affected by thrombosis are the femoral, iliac, popliteal, tibial and peroneal. More rarely there is thrombosis in the saphenous veins. In the later stage, the veins may be inflamed and adherent to the surrounding cellular tissue ; especially when the commencement of the affection has been by extension from pelvic cellulitis. The lymphatic glands are generally enlarged, the lymphatics matted together with the vessels by inflammatory exudation. The clot may be found softened down by fatty degeneration. When the affection is part of general septicæmia, the clot is more disintegrated, and there may be pus in the veins.

Sequelæ.—As a general rule, the clot shrinks up or becomes disintegrated, and the circulation through the affected vessels is restored. More rarely the vessels become permanently obliterated. In these cases, more or less swelling, or tendency to swell, may remain in the leg for months and even years, and the use of the limb is impaired for a corresponding time. In either case, a varicose condition of the veins which have been distended in consequence of the obstruction is apt to remain.

Rarely suppuration takes place about the affected vessels. This usually ends favourably after the opening of the abscess. When, however, the septic character predominates in the affection, and especially in lying-in hospitals, extensive burrowing abscesses may be formed, with sloughing of muscles and cellular tissue. Under similar conditions, the thrombi may become disintegrated and form septic emboli which set up general pyæmia. Even a healthy clot may be detached and cause embolism of the pulmonary artery. The consequence may be sudden death, or serious embarrassment to respiration. Fortunately, the detachment of a clot is rare, except as the result of premature exertion or injudicious manipulation of the affected veins.

Treatment.—The first essential in treatment is absolute rest, and this must be prolonged for a considerable time, with a special view to the danger of embolism of the pulmonary artery. For the same reason all friction should be avoided, and manipulation of the affected vessels should be used only with great caution. The affected leg should be somewhat elevated, and guarded from pressure by a cradle. For relief of pain it may be wrapped in thinly-spread linseed poultices, hot fomentations, or in flannel moistened with an anodyne lotion, and covered with oiled silk. Opium or morphia should be given until the pain is relieved. Quinine in moderate or considerable doses, according to the degree of pyrexia, is of most value in the acute stage. Later, the tincture of perchloride of iron may be given. In the later stage, when the swelling is subsiding, the leg may be bandaged evenly with a flannel bandage, and still kept elevated. The patient should on no account be allowed to leave her bed till all tenderness and swelling of the vein have disappeared. In the septic forms of the disease the treatment will be merged into that of puerperal septicæmia.

It was formerly recommended to apply leeches over the inflamed vein, and even to repeat the leeching on successive occasions, and also to apply blisters to the affected limb. Since the disease is one associated with debility, and frequently a sequela of hæmorrhage, leeching is not desirable, even though it might give relief to local pain. Blisters are only likely to increase the distress.

EMBOLISM AND THROMBOSIS OF THE PULMONARY ARTERIES.

Attention has long been attracted by the startling cases in which, quite unexpectedly, sudden death occurs either during labour or, more frequently, after delivery. It is now recognised that the most frequent cause of sudden death is embolism of the pulmonary arteries. This embolism is, in the majority of cases, the sequel of thrombosis in the veins of the uterus or its vicinity, or in the iliac or femoral veins. It may occur at any time up to four or five weeks after delivery, but is more common after a certain interval, when changes may have taken place in the clot which promote its detachment. Embolism may occur, however, even before delivery, and when this is the case, the clot is most likely to be derived from a thrombus in a uterine sinus at the placental site. In this situation, ante-partum thrombosis may occur if there has been separation of the placenta, and the thrombus is likely to be more bulky than that which would have been formed after delivery and retraction of the uterus. Then, when retraction does occur in the course of labour or after delivery, the loose thrombus may be squeezed out and carried to the pulmonary arteries. According to Spiegelberg,* this accident most often occurs when premature labour is induced by some method which involves the risk of separating the placenta.

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* Lehrbuch der Geburtshülfe, 2nd ed., p. 603.

The predisposing causes are therefore all those which tend to coagulation of the blood, especially hæmorrhage, depression of the circulation from hæmorrhage or exhaustion, pyrexia due to any cause, and the entrance of septic material into the circulation. It is only the milder forms of septic infection, however, which are likely to lead to sudden death through embolism of the main trunk or largest branches of the pulmonary artery. If the clot itself has a definitely septic character, and contains septic organisms, it quickly becomes disintegrated. Small fragments are then apt to be detached, and either plug small branches of the pulmonary artery, or pass through the pulmonary capillaries and cause minute emboli in other parts of the body. This condition has already been described in the chapter on puerperal fevers as leading to visceral pyæmia. The clot may, however, be apparently healthy, even though entrance of septic material has had something to do with the coagulation: perhaps because the influence has been that of sapræmia only, not septicæmia (see p. 777). In such case, if detached at all, it is more likely to be detached in a considerable mass, and plug a large branch or the main stem of the pulmonary artery.

Considerable controversy has taken place as to whether individual cases should be interpreted as embolism or as primary thrombosis of the pulmonary artery. On the one hand it is argued, and the argument has much weight, that it is not likely that coagulation should take place first in a situation where the current is so rapid as it is in the pulmonary arteries. On the other hand it is said that the pulmonary artery breaks up at once into a number of branches, which radiate from it at different angles to the several parts of the lung. Consequently a large extent of surface is presented to the blood, and there are numerous angular projections into the currents; both which conditions are calculated to induce the spontaneous coagulation of the fibrin.* This mode of bifurcation must also cause considerable retardation of the current, which may therefore become slow enough to allow coagulation when the heart's action is greatly depressed.

Extensive coagulation may be found in the pulmonary arteries and right heart after death, having the appearance of being due to thrombosis. It is to be remembered, however, that an embolus always causes the deposit of fresh fibrin on its surface, and thus leads to secondary thrombosis, extending backward toward the heart. A small primary embolus may thus escape detection. Moreover, it is often difficult to say whether the extensive thrombosis may not have been formed only during the death agony.

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* Humphry, "On the Coagulation of the Blood in the Venous System during Life."

Most of the best pathologists however, are of opinion that embolism of the pulmonary arteries is much more frequent than primary thrombosis. An embolus is distinguished by its being more decolorised and distinct in appearance from the thrombosis formed upon it, and by its generally being situated at a point of bifurcation of the artery, at which it has been arrested. Also it is not moulded in shape to the vessel which contains it, and occasionally it may be fitted on to the clot elsewhere from which it has been detached.

An ante-mortem arterial thrombus presents a rounded end toward the heart, and is dense, consisting of layers of decolorised fibrin. It may be softened in the centre from commencing degeneration. It is non-adherent to the walls of the vessel, and may allow a little space for the blood to circulate between.

Playfair is one of the strongest advocates for the relative frequency of primary thrombosis of the pulmonary artery. In an analysis of 25 cases of sudden death after delivery, he regards 15 out of the 25—in all of which death occurred before the fourteenth day, often on the second or third—as due to primary thrombosis. In 7 only he found that there was distinct evidence of embolism, and in them death occurred at a remote period after delivery; in none before the nineteenth day. He infers that time is required to admit of degenerative changes taking place in the deposited fibrin, in order to lead to the separation of an embolus. It is to be remembered, however, that an embolus separated from a recent clot would show much less sign of change, would be more difficult to distinguish from the secondary thrombus formed upon it, and would therefore much more readily escape detection, especially by a pathologist not of great experience.

A coagulum formed in the pulmonary artery within a few days after delivery need not necessarily either be due to primary thrombosis in that situation, or be derived from a thrombus in a vein. A clot may be formed in the right auricle, commencing probably in the auricular appendix, where there is little current, or in a small vein opening into the auricle. Thence a thrombus may extend into the ventricle, and even into the pulmonary artery, while still tethered in the auricle. From this thrombus a portion may be detached, and plug a branch of the pulmonary artery.

A case recorded by Playfair himself as a case of thrombosis of the pulmonary artery appears to indicate this mode of origin.* Labour had been severe and protracted, and the patient greatly exhausted.

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* "Note on the Absorption, with Ultimate Recovery, of Thrombosis of the Pulmonary Artery in the Puerperal State." Obstet. Trans., Vol. XXVI.

After delivery temperature had fluctuated considerably, often reaching a high point, and rarely or never becoming normal ; there had been one or two paroxysms of dyspnœa. Three weeks after delivery Sir W. Broadbent found a bruit indicating thrombosis in the right auricle. Phlebitis was just beginning in the left posterior tibial vein. A few days later there were symptoms of embolism of a branch of the pulmonary artery leading to the lower part of the left lung, namely, impaired resonance, imperfect entry of air, and loud, harsh friction. The auricular murmur was no longer audible, but there was a systolic murmur over the pulmonary artery, and obscuration of the pulmonary second sound, the coagulum interfering with the proper closure of the valves. Just at this time thrombosis of the right iliac vein appeared, and extensive phlegmasia dolens of the right leg was developed. The patient eventually completely recovered. Sir W. Broadbent's interpretation was, that there was extension of the thrombus from the auricle into the ventricle and pulmonary artery, and consequent embolism of a branch of the pulmonary artery.

From cases in which signs of pulmonary obstruction have shown themselves without proving immediately fatal, and phlegmasia dolens has appeared shortly after, Playfair argues that the peripheral thrombosis obviously followed the central, both being produced by identical causes, and in the instance related above this seems to have been certainly the fact. They may be open, however, sometimes also to the interpretation that thrombosis in a pelvic vein may first have led to the detachment of an embolus, and afterwards have extended to an iliac vein and produced phlegmasia dolens ; or that thrombosis may have occurred successively in two or more veins, as is often found to be the case.

One fact about the clinical history is in favour of the view that embolism is much more frequent than primary thrombosis of the pulmonary artery. This is that, in the great majority of cases, the attack comes on with an appalling suddenness, which forms one of its most striking characteristics. It is thus allowed that there is no difference in symptoms between embolism and what is interpreted as having been primary thrombosis. It might be expected, however, that the onset of symptoms would be more gradual in thrombosis, as it seems to have been in the case recorded above, where thrombosis commenced in the right auricle.

The cases which are most likely to be due to thrombosis commencing either in the auricle or in the pulmonary artery itself are those in which the symptoms of dyspnœa come on within a few days after delivery, and in which they have been preceded by great depression of the circulation, owing to exhaustion from difficult labour, or hæmorrhage, or both.

Symptoms and course.—The primary thrombosis in a pelvic vein, if such has existed, gives, as a rule, no sign of its presence. Hence the attack of dyspnœa, in the majority of cases, comes on quite unexpectedly. In some cases the puerperal period has apparently progressed quite normally, and the patient may be beginning to get about again. Frequently, however, there has either been a protracted and exhausting labour, or there has been more or less pyrexia within the first week, indicating some degree of septic disturbance. In other cases, again, the attack comes on within the first few days, especially after hæmorrhage, or depression of the heart from exhaustion.

The starting-point appears frequently to be some slight exertion. The patient is then suddenly seized with the most intense dyspnœa. She gasps and struggles for breath, and all the auxiliary muscles of respiration are thrown into action. The face is livid and purple, or sometimes pale. The heart's action at first is violent and tumultuous; soon it becomes feeble and irregular. The pulse is small and also irregular. Respiration is hurried, and air may be heard to enter the lungs freely.

If the main trunk of the pulmonary artery is blocked, death follows after a struggle of a few minutes. If only a main branch is plugged, the symptoms after a while may become mitigated in some degree, but the violence of dyspnœa is apt to be renewed on any slight exertion. Less frequently, the first onset is not so intense, but the attacks recur with increasing severity. This probably happens chiefly in cases in which there is primary thrombosis in the heart or in the pulmonary artery itself. A fair number of cases has been recorded, although only a small minority of the whole in which the patient has ultimately recovered after symptoms pointing to pulmonary embolism or thrombosis.

In some of the cases not very rapidly fatal a systolic bruit has been observed over the pulmonary artery. It is probable that this may occur in the case of embolism at the entrance of a main branch of the artery, when the secondary thrombus extends towards the heart. If a primary thrombus is tethered in the heart, and extends through the valves into the artery, the bruit may be expected to be more marked. In this case the second sound may also be affected, as in the instance described at p. 826, the clot preventing the closure of the valves. If the patient eventually survives, recovery is complete. The circulation is restored, probably through disintegration of the clot, and any bruit which may have been heard disappears.

Prophylaxis.—The most essential point in prophylaxis is to enjoin complete and prolonged rest in all cases in which there is evidence of venous thrombosis. This should be continued until at least five or six weeks have passed, and the vein is no longer tender and indurated. More prolonged rest in bed than usual is also desirable in all cases in which there has been great exhaustion from hæmorrhage, or considerable pyrexia indicating septic disturbance in the first week after delivery.

Treatment.—In many cases death is too rapid to allow any treatment. In the first instance the effort should be to keep the patient alive, and maintain the action of the heart by stimulants such as brandy and ether. Ether may be given by subcutaneous injections of twenty minims at a time, if the patient cannot swallow. Ammonia is a useful stimulant, and has also been recommended on the ground that it may tend chemically to promote the solution of the clot, or, at any rate, to prevent further thrombosis. Twenty minims of liquor ammoniæ, or five grains of carbonate of ammonia, may be given every hour for a while, and afterwards at longer intervals. If there is cyanosis of the face, and other evidence of over-distension of systemic veins, a small venesection, or some leeches applied to the chest, may assist in the restoration of equilibrium.

If the patient survives the first attack of dyspnœa, and obtains some relief, it is of the utmost importance that she should be kept absolutely at rest, and not raised in bed, or allowed to make any muscular exertion for any purpose. Liquid food should be given frequently, and in small quantities. The same precautions should be maintained for a considerable time after the severity of symptoms has abated, since a renewed attack is liable to be brought on by any imprudence.

EMBOLISM OF SYSTEMIC ARTERIES.

Embolism of systemic arteries is rarer than that of pulmonary arteries. In the majority of cases the clot is derived from the left heart. The same conditions of blood as those which predispose to venous thrombosis promote its formation. In some recorded cases there has been antecedent rheumatism, and vegetations have been detached from the valves of the heart. In others there has been puerperal endocarditis, generally of septic origin. In others, the thrombosis probably commences in the auricular appendix, or elsewhere in the auricle, the circulation having been much depressed by exhaustion or hæmorrhage. In some cases it has been inferred that there has been primary thrombosis in the arteries themselves, the symptoms having been gradual in their onset, and the arterial walls having been found in a morbid condition.

Symptoms and course.—The arteries most frequently affected are the femoral, brachial, and cerebral. When the artery of a limb is plugged, there is generally intense pain in the situation of the affected artery, sudden in its origin, but persistent. Pulsation in the distal portion of the artery ceases, and the limb becomes cold, powerless, and sometimes œdematous. There may be excessive pulsation in the artery above the plug. In some cases gangrene of the limb has followed. Gangrene is not generally the result of obstruction of the main artery of a limb in persons who are young and otherwise healthy, a collateral circulation being established. Hence, in the puerperal cases, a morbid condition of the blood, or some venous thrombosis in addition, is probably an element in the causation. When gangrene of a limb occurs in the puerperal state, the prognosis is most grave. Cases, however, are on record in which the patient has recovered after formation of a line of demarcation and amputation of the limb.

When embolism of an important cerebral artery occurs, softening of the brain and paralysis, generally taking the form of hemiplegia, are apt to follow. Embolism of the ophthalmic artery leads to complete blindness of the affected eye. This generally occurs in septicæmic cases, and is followed by destruction of the eye, and usually by a fatal result.

Treatment.—The limb should be elevated and kept warm by flannel and hot-water bottles. Opiates must be given until pain is relieved. The strength should be supported by nourishing diet. Any concomitant septic condition must be treated in the usual way.

ENTRANCE OF AIR INTO THE VEINS.

Next to pulmonary embolism and thrombosis, the most notable cause of sudden death during labour or shortly after delivery appears to be entrance of air into the veins. It is well known that the entrance of air in considerable quantity into large veins near the heart is apt to prove fatal. This is sometimes seen in surgical operations upon the neck. The condition of the uterine veins is somewhat similar to that of the veins at the lower part of the neck. They have large mouths, and are closely united with the tissue in which they lie, so that they cannot collapse when not closed by contraction of the uterus. They are also near enough to the chest to be affected by respiratory aspiration.

The cause of death in such cases is probably complex. The right heart filled with air, which is compressible and has no appreciable momentum as compared with blood, cannot readily empty itself. The air bubbles also do not readily pass through the pulmonary capillaries, and act somewhat as emboli. If the air enters a vein distant from the heart, or enters in moderate quantity, so that the right heart does not become filled with air, these effects are not produced.

For air to enter the uterine veins three conditions are necessary. There must be air or gas in the uterus, the uterus must be relaxed, and the mouths of the veins must be open, or filled only by a soft easily displaceable thrombus. The conditions may be fulfilled either before delivery, when the placenta is separated or partially separated, or after delivery, especially when delivery is only just completed. Air may reach the vagina and thence the uterus merely from the effect of position, when the vagina is patulous. It may also still more easily gain access during obstetric operations or manipulations. Aspiration into the veins may occur from the variations of intra-abdominal pressure, together with relaxations of the uterus alternating with contractions. Air may also be forced into the veins by contraction of the abdominal muscles, occurring when the exit through the vagina is impeded.

The most marked cases have occurred when water has been injected into the uterus before delivery. The placenta may then be separated by the pressure of the water, and air already in the vagina may gain entrance, or air may be injected with the water. If a Higginson's syringe is used, air is almost certain to be injected. The objections on this ground to the method of inducing labour by injections of water into the uterus have already been explained (see p. 590). The same result has sometimes followed even a vaginal douche; and it has been thought that, even if no air has been injected with the water, the pressure of the water may have forced into the uterus some air already in the vagina. Again, sudden death has followed the washing out of the uterus for the removal of septic material after delivery.

In other cases sudden death has occurred shortly after delivery, and the entrance of air into the circulation has been verified by autopsy. In some of these instances, the accident has happened when the hand has been introduced into the uterus, as for the removal of an adherent placenta; in others it has been quite spontaneous. Another mode of origin for the accident is the distension of the uterus by gas from decomposition of the fœtus. On delivery of the fœtus and separation of the placenta, some of the gas may then be aspirated or forced into the veins.

On post-mortem examination, the left heart is found contracted, the right heart distended and filled with air. There is froth in the pulmonary arteries. The vena cava and pelvic and uterine veins may contain air. It is, of course, necessary to distinguish the case in which gas has been produced by post-mortem decomposition.

Symptoms.—The symptoms indicate pulmonary obstruction, and thus closely resemble those of pulmonary embolism. There is a sudden intense struggle for breath; the face is purple and livid, the pulse small and irregular. Sometimes convulsions occur. Soon unconsciousness and death follow. A churning sound in the heart has sometimes been heard on auscultation. As a rule, however, it will be impossible positively to distinguish between entrance of air into the circulation and pulmonary embolism.

Prophylaxis.—Induction of premature labour by injection of water into the uterus should be avoided. Even for the vaginal douche, an irrigator should be used, and the tube should be emptied of air. If the Higginson's syringe is ever used care should be taken that the outflow from the vagina is free, and the injection should be gentle at first.

Syncope and Shock.

In cases of serious valvular disease of the heart, fatal syncope is apt to occur during or after labour, as already described (see p. 384). Apart from any valvular disease, various cases of sudden death in parturition or the puerperal state are on record, in which the results of post-mortem examination have excluded the possibility of embolism or thrombosis of the pulmonary arteries, or the entrance of air into the circulation. These must be attributed to failure of the heart. It is a comparatively common experience that, after post-partum hæmorrhage not sufficient in amount to kill under ordinary circumstances, fatal syncope may occur, sometimes from the effect of some exertion, or of the patient's head being raised imprudently. Even without any excessive hæmorrhage, syncope may occur, and in some cases has been fatal, especially when the patient has been exhausted by severe labour. Predisposing causes may be the so-called fatty degeneration of the muscular fibres of the heart, or mere thinness of its muscular wall, which is generally associated with deposit of adipose tissue outside. Dilatation of the heart from any cause, such as Bright's disease, or disease of the lungs, may also predispose to syncope. Death from syncope has occurred in pregnancy, as well as during or after labour, but much more rarely.

Sometimes the approach of death is more gradual, and is preceded by symptoms resembling those of shock. The face is anxious and pinched, the skin pale, the lips livid, the extremities cold, the pulse rapid and almost imperceptible, the skin generally moist with sweat. There is an absence of the violent struggle for breath and tumultuous action of the heart which denote pulmonary obstruction. Sometimes, as when death is impending from the effect of severe hæmorrhage, there is restlessness associated with considerable strength of voice and muscular strength generally, but with very rapid feeble pulse. These symptoms chiefly occur after severe labour in women of highly susceptible neurotic temperament, and the shame of parturition in an unmarried woman sometimes adds to the effect. Some excess of hæmorrhage may also be concerned in their production. The sudden lowering of abdominal tension is probably an element in the causation. Combined with a paralysis of the sympathetic nerves, due to the impression upon the nervous system, it allows a great proportion of the blood to collect in the large veins within the abdomen, while but little passes through the heart.

Treatment of shock.—The treatment is to apply warmth to the extremities, and give stimulants, such as brandy, ether, and ammonia, as well as liquid nourishment, as strong beef-tea or essence of meat. Ether may be administered subcutaneously. If failure of the heart is threatened, the inhalation of nitrate of amyl is likely to be of use, as it is in threatened syncope during the administration of chloroform: for it acts, not only by relaxing the arteries, but by stimulating the heart, as may be proved by sphygmographic tracings, and thus it relieves the circulation in a double way.

OTHER CAUSES OF SUDDEN DEATH.

Sudden death from rupture of an aneurism in labour, rupture of the heart, or rupture of the spleen, have been recorded, but are very rare. In women prone to cerebral hæmorrhage the exertion of labour may precipitate the rupture of an artery. There may then be convulsions at the outset, followed by coma and paralysis, generally hemiplegia. Death in this case may be rapid, but is not absolutely sudden, as when due to failure or obstruction of the circulation.

Some causes of sudden death would not be suspected unless revealed by post-mortem examination. Thus, a woman in the Guy's Hospital Lying-in Charity, somewhat advanced in apparently normal labour, became suddenly collapsed, and died before delivery could be completed with forceps. At the autopsy, it was found that the omentum was adherent to the uterus. Some separation had occurred, probably from the retraction of the uterus with the advance of labour, and fatal hæmorrhage had taken place into the peritoneal cavity.

DECIDUOMA MALIGNUM.

A peculiar form of malignant disease following pregnancy was first described by Sänger in 1888 under the title of "Deciduoma malignum." Chiari had previously described three cases of carcinoma of the fundus uteri following the puerperium, of which two occurred in young women aged 22 and 23. Since 1888 a considerable number of cases have been described, more than 40, chiefly by German authors, and recently a few have been recorded in England and America. The chief clinical features of the disease are that it both spreads locally and forms metastatic deposits with extreme rapidity, so that, in the greater number of cases, it has proved fatal within from ten weeks to six months after the puerperium. It may occur at any age from 20 to 55 ; but a large proportion of cases have been in young women. Thus, about 64 per cent. of the patients have been under the age of 35 ; and there are more cases between the ages of 25 and 30 than in any other quinquennium.

Causation.—The disease may occur after labour at full term or premature, after abortion, or after a vesicular mole. Premature deliveries and abortions are in greater than the relative proportion as compared with full-term deliveries. But the most remarkable circumstance in the causation is the relation to vesicular mole, which was the antecedent in 45 per cent. of the cases. The disease is almost entirely, if not entirely, confined to multiparæ.

Pathology. — Three different forms of growth have been described and figured in the cases described under the head of Deciduoma malignum. (i e) Foetal Epiblast

(1) In the greater number of cases, the characteristic feature of the growth is the presence of what is called the syncytium. This consists of masses of plasmodium containing large nuclei, but not divided into cells. It occurs sometimes in the form of irregular masses or bands, but frequently forms a reticulum, surrounding spaces which may contain blood, or cells similar to those seen in other parts of the growth. The rest of the tissue is made up of large cells with large nuclei resembling decidual cells. Whitridge Williams,* describing a growth of this kind, regards it as carcinoma, not sarcoma, for the reason that there is no ground substance or reticulum separating the cells, but only blood or threads of fibrin, and because there is no formation of vessels, the growth being nourished solely by blood in extravasated spaces. But the committee to which several specimens of a similar type were referred, in 1896, by the Obstetrical Society of London, regarded them as a form of sarcoma. Large spaces containing blood are a marked feature of the growth, and the syncytium appears to lay open the blood-vessels in a manner which has been compared to the function of the syncytium in the development

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* John Hopkins Hospital Reports. Baltimore, 1895.

of the normal placenta (see p. 70). Malignant cells have been found in thrombi within the vessels. In this way the very rapid formation of metastatic deposits, especially in the lungs, is accounted for.

There is much difference of opinion as to the origin of the syncytium. Some regard it as derived from the syncytium which constitutes the outer covering of the villi. The growth would then be a fœtal epithelioma engrafted upon the mother, if the view is correct that the outer covering of the villi belongs to the fœtal epiblast. There must also be a sarcoma mixed with this; but opinions differ whether the large cells are derived from the decidua, the deeper layer of (so-called) fœtal epithelium, or the stroma of the villi. Other authorities again deny the fœtal origin of the syncytium, saying that a similar syncytium may be seen in sarcomata in other parts of the body, formed by fusion of the sarcomatous cells. No instance has been produced, however, of a malignant growth of the uterus showing the syncytium, in which recent pregnancy could be excluded. The strongest evidence in favour of the fœtal origin of the growth consists in its relating to vesicular mole. Considering the rarity of vesicular mole compared with ordinary pregnancies and abortions (only one case in several thousand), the fact that a vesicular mole preceded in 45 per cent. of the cases is a proof that there is some causal relation between abnormal proliferation of the villi and the origin of the growth. Moreover, masses formed by proliferation of the syncytium may be seen in vesicular moles which give no evidence of malignancy.

(2) In some instances the growth consists of large cells resembling decidual cells, separated by a reticulum or intercellular substance. There is no syncytium beyond comparatively small masses of plasmodium, resembling the giant cells which are found in the decidua. This appears to be a form of sarcoma arising in the decidua, or in the mucous membrane modified by recent pregnancy. The cases first described by Sänger were of this nature. In this form of growth there is no clear demarcation, at an early stage, from the appearances seen in inflammation of the decidua associated with retention of a portion of placenta, especially after abortion. It differs from sarcoma of the uterus, as generally seen apart from pregnancy, in the large size of the cells and nuclei.

(3) In a few cases the primary and secondary growths have been villous in character, and these villi have been regarded by some as derived from the chorionic villi. Others deny that their appearance is identical. With the villous growth are associated syncytium, and also detached cells in the deeper tissues. Strong evidence in favour of the possibility of the implantation of a fœtal growth is

afforded by a case related by Apfelstedt and Aschoff,* in which the secondary growth in the labium and paravaginal tissue consisted of a vesicular mole, with the usual stalks and cysts. Metastasis of a vesicular mole to the lung has also been recorded. Again, in Müller's † case, the metastatic growths took the form of a row of cystic tumours in the vagina. In Neumann's case, following a vesicular mole, chorionic villi were found in a metastasis, as well as in the original growth. Syncytium and detached cells with large nuclei were also present. I have met with a case in which a vesicular mole was followed by myxoma of the uterine wall. This appeared for a time to be running a malignant course, but eventually died out, after repeated removal.

Early metastasis is a feature in all the varieties of growth, and the metastatic growths have a similar microscopic appearance to the primary. Deposits were observed in the lungs in more than 50 per cent. of the cases. In over 30 per cent. there were metastases in the vagina or vulva. Free hæmorrhage takes place into the growths. They also break down easily, and hence septicæmic complications occur early. Death sometimes takes place through thrombosis or embolism.

Symptoms and course.—The characteristic symptom is irregular hæmorrhage commencing within a few weeks after delivery or abortion, or vesicular mole. Later there is anæmia with pyrexia, rigors, and other symptoms of sapræmia or septicæmia. Sometimes masses of growth are discharged. Before death there may be evidence of affection of the lungs, and frequently metastatic growths appear in the genital canal.

Diagnosis.—In case of hæmorrhage persisting after delivery, abortion, or still more, after vesicular moles, no time should be lost in exploring and curetting the cavity of uterus. Microscopic examination should be made of any masses brought away.

Treatment.—The only hope of cure is in very early hysterectomy, which should be carried out by the vaginal method. Metastatic growths in the vagina or vulva, if limited, may be removed at the same time. There have been two instances of patients being still free from recurrence, one at six months, one at eighteen months, after such an operation.‡

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* Archiv. f. Gynäk., 1896, p. 511.

† Verb. d. Deutsch. Gesell. f. Gynäk., 1891, p. 341.

‡ The most important cases of deciduoma malignum will be found in the following papers:—Chiari, Wiener Med. Jahrb., 1877, p. 364; Sänger, Centralbl. f. Gynäk., 1889, p. 132; Gottschalk, Arch. f. Gynäk., vol. xlvi. p. 1; Marchand, Monatschr. f. Geb., 1895, p. 513; Whitridge Williams, John Hopkins Hospital Reports, 1895; Neumann, Monatschr. f. Geb., 1896, p. 387; Spencer and Morison, with discussion on papers, Obstet. Trans., 1896.

CHAPTER XLI.

PUERPERAL INSANITY.

Puerperal insanity may be divided into four classes:—the insanity of pregnancy, that of labour, that of the puerperal state, and that of lactation. The important influence which child-bearing has in reference to mental diseases is proved by the notable proportion of patients admitted to lunatic asylums in which the disease is attributed to this cause. By various authors this proportion is estimated at from 8 to 12 per cent. At Bethlem Hospital, out of 1,333 female patients admitted from the year 1864 to 1874 inclusive, 14·7 per cent. owed their insanity more or less to causes related to pregnancy or childbirth.* It is to be remembered, moreover, that most of the milder and more temporary forms of disease are treated at home.

Puerperal insanity may assume any of the forms of insanity in general. The only peculiarity about it is its relatively good prognosis. This is another circumstance proving the veritable character of the influence exercised by pregnancy; for after the effect produced by this exciting cause has died away, cure results in the great majority of cases; and thus, in this respect, puerperal insanity is in contrast to insanity in its other forms. Not every case, however, of insanity occurring during pregnancy or after delivery has those conditions for its cause.

Puerperal insanity resembles other forms of the disease in that hereditary tendency is of great importance as a predisposing cause. From this point of view must be taken into account the occurrence in relations, not only of actual insanity, but of other neuroses, such as hysteria, epilepsy, chorea, and the like. Savage found distinct acknowledged insanity in the family in 31·4 per cent. out of 207 cases; Reid in 40·5 per cent. out of 111; Tuke in 31·5 per cent. out of 73; Hellyt in 38·8 per cent. out of 131. In about as many more cases a history of some other neuroses in the family may be discovered.

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* Savage, "Observations on the Insanity of Pregnancy and Childbirth." Guy's Hosp. Rep., Third Series, Vol. XX.

Of the three principal forms of puerperal insanity, namely, those of pregnancy, the puerperal period, and lactation, the insanity of pregnancy is the rarest, and that of the puerperal period the commonest. The following are the proportions according to various authors :—

	Marcé.	Tuke.	Weber.	
Insanity of pregnancy . . .	8	18	15	per cent.
Insanity of the puerperal period	58	47	58	,,
Insanity of lactation	33	35	26	,,

In all the forms of puerperal insanity there is generally association with debility, exhaustion, or impoverishment of blood. In all of them some mental impression, such as a bereavement, fright, sudden bad news, anxiety about children, or quarrel with relatives, may be the exciting cause of the outbreak. Thus, in times of war and revolution puerperal insanity is more common than usual.

In all the varieties, but especially in the insanity of pregnancy and the puerperal period, the grief and shame of seduction form an important predisposing cause in many cases. Another cause, which may be met with in each division, is rapid child-bearing. The exhaustion of repeated child-birth and lactation may be sufficient to call a predisposition into activity, especially if there is hereditary taint.

To all the forms of insanity, but especially to those of pregnancy and the puerperal state, primiparæ are most liable. On the other hand, increase of age increases the proclivity. Thus between the ages of 20 and 30, about 70 per cent. of the births take place, but only 56 per cent. of the cases of insanity occur then ; between the ages of 30 and 40, 20 per cent. of the births take place, but 35 per cent. of the cases of insanity occur ; less than 1·5 per cent. of the births take place after the age of 40, whereas 8·6 per cent. of the cases of insanity occur after that age (Marcé). In some cases insanity has been developed in the puerperal period after a first pregnancy ; while on a second occasion, it has come on during pregnancy, thus apparently indicating a progressive vulnerability under the influence of the disturbing cause.

Tyler Smith* relates the case of a patient who, out of seven deliveries, had twins three times. On each of these three occasions she suffered from puerperal mania.

Insanity of pregnancy.—The tendency of pregnancy to call into activity other neuroses, such as hysteria and chorea, has already been described. It is accounted for partly by the presence of a local source of reflex irritation, partly by the increase in pregnancy of the irritability of the nerve centres to prepare them for the work of parturition. The influence of pregnancy with regard to insanity must be explained, in part, in the same way. The well-known unnatural longings of pregnancy may also be regarded as having some relation to insanity ; for in some cases these proceed to such a length as to amount to moral perversion, as, for instance, when they take the form of dipsomania or kleptomania.

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* "Manual of Obstetrics."

The anæmia and deterioration of blood which are common in pregnancy may often have to do with the causation. In some instances albuminuria, or the blood changes resulting from jaundice, have been regarded as a cause.

A mental cause frequently present is the fear or conviction, so commonly met with in pregnant women, especially those pregnant for the first time, that the result of delivery will be fatal. In many cases the development of melancholia out of this despondent frame of mind can be traced. It is a further proof of the relation between the two conditions that the insanity of pregnancy takes the form of melancholia in the great majority of cases. Out of 28 cases recorded by Tuke, there was melancholia in 20, typical mania in only 2 ; out of 10 recorded by Savage, there was melancholia in 7, and typical mania in only 1.

With the melancholia more or less of dementia is associated in a minority of the cases. Disposition to suicide is strong. If the insanity persists after delivery, there may be a homicidal tendency towards the infant. There may be refusal of food, and the delusion that attempts are being made to poison is not uncommon. There is generally apathy and indifference towards husband and friends. Erotic manifestations are comparatively uncommon. The tendency to moral perversions, such as dipsomania and kleptomania, sometimes without other evidence of insanity, has been already mentioned. Insanity may come on at any time during pregnancy, but generally after the second or third month.

Prognosis.—The great majority of patients recover, but usually not till after delivery. In a few instances, however, when insanity comes on in the early months, the patient recovers before delivery. There is, however, a liability to relapse after delivery. According to Spiegelberg, the prognosis is more favourable when the insanity comes on in the early months. Of Savage's cases, 90 per cent. recovered within twelve months. The average date of recovery was six months after delivery. When the insanity takes a form different from that usual during pregnancy—that is to say, when there is mania rather than melancholia—the prognosis is less favourable.

The insanity of labour.—In some cases of labour a kind of transitory mania or delirium is produced by the intensity of the pain. The patient, in her frenzy, may injure herself, or, more frequently, injure the child, the excitement reaching its height just at the final pains, when the head passes the vulva. As might be expected, this is more common in primiparæ, in whom greater pain is produced in the distension of the perineum, and inevitable laceration of the vaginal outlet. The mental agony resulting from seduction may add to the effect. There is a medico-legal interest in the question, since it has generally been held, when a woman has been delivered alone, and is accused of having committed infanticide immediately upon the birth of the child, that the deed may have been done under the influence of transient mania. As a rule, the maniacal excitement passes off as soon as the child is born, and it may therefore be questioned whether this transient frenzy should really be classed as insanity. There is a resemblance, however, to insanity in the fact that delusions are sometimes manifested. Moreover, in a few cases, though the excitement passes off for a time, other mental symptoms, such as melancholia, are developed a little later. The maniacal excitement must then be regarded as the first symptom of the disease. Two cases of this kind are recorded by Savage.

The insanity of the puerperal period.—This, as already explained, is the most common form of puerperal insanity. There is no positive line of demarcation between it and the insanity of lactation, but it is generally regarded as including all cases occurring within two months after delivery. Of these, the great majority are developed within the first fortnight, and extremely few after the first month. The insanity of lactation, on the other hand, generally comes on when the patient has been weakened by many months' nursing.

Causation.—Besides the general causes already enumerated (see p. 838), the chief causes operating in the production of this variety are the effect upon the nervous system produced by the shock of labour and the subsequent exhaustion. The disease is therefore promoted by anything which increases either of these effects, especially difficult or painful labour, or excessive hæmorrhage. Anæmia is, indeed, almost always a marked feature in the patient. Some mental impression, such as grief at the loss of a child, is present in a large proportion of cases (46 out of 92, according to Esquirol). The shame resulting from seduction has an important influence according to some, but Savage has found insanity after illegitimate childbirth to be comparatively rare.

In some cases of neurotic patients, or those predisposed to insanity, the delirium accompanying some form of puerperal fever takes a maniacal aspect. The delirium then varies in proportion to the fever, and subsides with it. In other cases, again, the puerperal fever appears to be the starting-point of the insanity, just as any other kind of acute disease may be. The insanity then remains after the pyrexia has subsided. Other acute disorders, complicating the puerperal state, which have been observed as the antecedents of insanity, are rheumatic fever, scarlatina, and mammary abscess.

Sir J. Simpson held that puerperal insanity was frequently the result of uræmia, but other authorities have found albuminuria to be very rarely present. Savage, however, records a case in which slight albuminuria was present only during the period of excitement, a condition not found in ordinary acute mania. Sir J. Simpson, indeed, stated that the albumen disappeared from the urine within a short time after the access of the malady; but, in such case, the insanity can hardly be regarded as uræmic. Insanity has occasionally been a sequel of eclampsia, but only in rare cases.

Puerperal insanity may occur after an abortion as well as after labour, although not so frequently. Sometimes it recurs in successive pregnancies. In other cases, after a first attack of puerperal mania, some uterine disorder, or an ovarian tumour, may cause a recurrence. I have known very acute mania, resembling puerperal mania, and followed by rapid recovery, to be the sequel of the operation for the incision of the cervix uteri.

Clinical course.—In the majority of cases the form taken is that of mania (in 57 out of 73 cases, according to Tuke). This is especially the case when the outbreak takes place within a fortnight after delivery. There may be premonitory signs of mental disturbance. Generally there is sleeplessness; the patient may take an unreasonable dislike to the nurse, or alter in her manner to her husband. The maniacal outbreak may be sudden. Generally it is marked by extreme restlessness of motion and incoherent voluble speech. Throughout the incoherence may be sometimes traced a prominent delusion, or some idea which had previously occupied the patient's mind. Hallucinations of vision are frequent. The patient may violently resist being kept in bed, may tear off her clothes, or try to throw herself out of the window. She is often violent towards relations, takes a dislike to her husband, and is apt to try to destroy the child. The suicidal tendency is also often marked. In a few cases the mania comes on very suddenly—within a few days after delivery—and passes off as suddenly. Patients in this state may destroy their children or injure themselves or others, and the explosion may suddenly restore the balance of reason. The condition is therefore one of medico-legal importance.

In other cases the onset is not so violent. The patient at first may merely be incoherent, may refuse food, or may show signs of delusion; but, in all cases which occur within the first fortnight after delivery, an outbreak of violence is to be apprehended.

The pulse is rapid when excitement is present, but the temperature is not generally elevated, unless the insanity is dependent upon, or associated with, some other cause of pyrexia, such as septic disturbance. The tongue is usually coated, and the bowels often constipated. Evacuations may be passed involuntarily, or without regard for decency. There may be filthy habits, such as eating excrement. Food is often refused. The urine is scanty, and contains excess of urea, urates and phosphates, in consequence of the increased waste of tissues. The lochia and secretion of milk are generally suppressed or diminished at the outset of the disease. This circumstance is to be regarded, as a rule, as a consequence, and not a cause of the insanity. Sometimes, however, especially within the first week, it may indicate a septic disturbance, which is itself exciting the insanity. It will then be associated with elevation of temperature. The incessant restlessness of body and mind, sleeplessness, and difficulty about feeding often lead to great wasting, and increase of that anæmia which is usually present from the first.

An erotic tendency is rather common, and women may use in their ravings obscene and profane language which they would hardly have been thought likely to be acquainted with. Delusions of a sexual kind may be prominent, and the patient may falsely accuse herself of unchastity. Masturbation is pretty frequent. This tendency may be associated with the fact that the exciting cause of the disease is an affection of the genital organs. It is apt to persist throughout its whole course.

I have met with a case in which, after an early abortion, and great disappointment in consequence, mania took the form of intense paroxysms, lasting only a few minutes, like epileptic attacks, and recurring several times in the day. In the paroxysm, the patient fought furiously with those present, under the delusion that they were devils carrying her to hell to prevent her having a child. It passed away quite suddenly, and she lay exhausted, but quite rational. The only suspicious sign in the interval was, that she wished to be left alone with one of her children and a knife, in order to prove that she was quite sane. This patient had to be removed to an asylum, but recovered after a few weeks.

Melancholia is more common in cases commencing later than the first fortnight after delivery, and the onset is commonly more gradual. In this form there is often religious despondency. Other moral causes, such as grief, ill-treatment, or poverty, are also more frequently operative than in mania. Sleeplessness is even more marked than in mania. The suicidal tendency is strong, even when there is an entire absence of delusions. It is also necessary to guard against infanticide. There is rarely any erotic tendency or evidence of masturbation. The patients usually suffer from constipation, and are averse from taking food, either from simple want of appetite or from delusions. Patients who show maniacal excitement at the outset of the disease may afterwards pass into melancholia or dementia.

Prognosis.—The patient rarely, according to Savage, dies from simple exhaustion, as sometimes happens with other forms of acute mania, but this result does occasionally follow. The chief causes of death were found by Savage to be pyæmia and phthisis. There were seven deaths in 78 cases of first attacks of puerperal mania recorded by him.

Probably the fatal cases are often not removed to asylums. Of four cases, occurring in 23,591 deliveries in the Guy's Hospital Lying-in Charity, all proved fatal; but this is an unusual result. One died from septicæmia, of which the mania was a complication; one from pneumonia; two apparently from exhaustion. In one of these two cases there was albuminuria.

If the patient does not die, cure follows in the great majority of cases. It may still be hoped for, even after the disease has persisted for twelve months. Sometimes, however, the patient lapses into permanent melancholia or dementia. Of the above 78 cases recorded by Savage, 13 patients were uncured at the end of from 12 to 18 months. The most frequent duration is from three to six months. In recurrent attacks the prognosis is less favourable, and the cure generally requires longer time. In melancholia, the average duration is somewhat longer. The greatest number of recoveries takes place from the fourth to the seventh month.

The insanity of lactation.—This form of insanity is commoner among the poor than among the rich, and commences in general physical weakness and anæmia. It is most frequent in multiparæ who have been weakened by numerous or quickly-repeated pregnancies. It may commence at any time, from two months up to eighteen months or more after delivery. In a few cases, the outbreak has followed almost immediately upon weaning. The majority of patients suffer from the outset from melancholia, and, even of those who are excited at the commencement, almost all become melancholic afterwards. The proportion of recoveries and the duration of the disease are similar to those in the insanity of the puerperal period.

Prophylaxis.—Marriage should be discouraged in women who have a strong hereditary disposition to insanity, and also, in most cases, in those who have already had an attack of insanity. Such advice, however, will generally not be followed. If pregnancy occurs in such women, the utmost care should be taken to maintain the health by nutritious food and hygienic management. If a patient has previously suffered from the insanity of pregnancy, and has premonitory signs of mental disturbance in a subsequent pregnancy, the question of inducing abortion with the hope of averting insanity may arise. In general, this proceeding is as likely to precipitate the insanity as to avert it, and the hope of benefit is therefore hardly enough to justify the sacrifice of the child.

Treatment.—As the disease so generally terminates in recovery, it is desirable to avoid sending the patient to an asylum, in order to avoid the consequent stigma, provided that she is in a position to secure the services of skilled attendants. Since she must be constantly watched, day and night, two attendants at least are necessary. In cases of violent mania, four may be required. With patients who are not wealthy, therefore, removal generally becomes necessary, unless the attack is mild, and of brief duration. If removal is likely to be necessary, it is well that it should take place early, since change of scene and complete separation from relations often have a beneficial effect. In the insanity of pregnancy, the consideration that the duration is likely to be longer than in the other forms may be an element in the decision.

The most important point in treatment is to maintain nutrition. If possible, the patient should be induced by coaxing to take an ample amount of solid food. If this does not succeed, liquids must be given. Forcible administration of food may be necessary in melancholia, and sometimes in mania. The best plan is to pass through a nostril a long thin œsophageal tube surmounted by a funnel, the patient being placed on her back. Gruel, or milk thickened with some farinaceous food, or eggs beaten up with milk, may be poured down.

Bromide of potassium is often useful in the early stages of excitement. Opiates must be used with caution, but it is desirable to attempt to procure sleep if there are successive restless nights. Chloral with bromide of potassium may be tried, or a hypodermic injection of morphia may be given. If the morphia does not succeed, it should not be pushed to large doses. It should be given only at bedtime, and should not be long continued. In melancholia, opiates often act better than in mania. Stimulants in moderation, given in the evening, often aid sleep, and diminish the necessity for opiates.

It is desirable that the patient should not see her husband, children, and relatives, especially if she has shown any dislike to them. In the later stages, change of air and scene often proves beneficial. In the convalescent stage, Savage considers that a return to cohabitation is beneficial, but pregnancy should be avoided for a considerable time.

CHAPTER XLII.

DISEASES OF THE BREAST.

Galactorrhœa.—Some excess in the quantity of normal milk at the commencement of lactation is not uncommon. The excess then generally escapes spontaneously. An equilibrium is usually soon attained through the increased appetite of the infant ; and the only treatment necessary is to limit somewhat the amount of liquid taken and keep the bowels acting rather freely by means of salines.

The term "galactorrhœa" is applied to those cases in which there is not only a persistent excess of milk, but the milk itself is thin and deficient in solids. This is generally a sign that the woman is in a debilitated condition, and unfit for suckling. Continual escape of such a thin secretion has been observed, not only in nursing women, but sometimes in those who have weaned, or have not suckled, or even during pregnancy.

Results.—The strength is soon reduced by the drain upon the system. There is generally loss of flesh. Shortness of breath and other signs of anæmia quickly appear. Some impairment of sight is common. Phthisis may supervene, and lead to a fatal result. The infant also does not thrive upon the poor milk. Sometimes menstruation returns in conjunction with the galactorrhœa, and may be excessive in quantity. The exhausting effect is then increased.

Treatment.—The child should be weaned, both for its own sake and the mother's. If the flow of milk still persists after suckling has been discontinued, gentle continuous pressure should be made upon the breasts. This may be carried out in the manner described at p. 288. At the same time glycerine of belladonna* may be applied to the breasts, or belladonna or atropia may be given internally. If these means do not readily succeed a few full doses (gr. x.—xx.) of iodide of potassium may be given. To recruit the strength, tonics, especially iron and quinine, and change of air are desirable.

Deficient secretion of milk.—In the absence of any febrile disturbance, a deficient secretion of milk generally depends upon some constitutional state not to be remedied by drugs. So long as there is hope that the mother will be able to suckle, even partially, the child should still be put to the breast, but at longer intervals than usual. If unsatisfied, it should be fed artificially immediately afterwards. The mother's diet should contain a good proportion of liquid, especially of milk or gruel made with milk, and should be as ample and nutritious as possible. Among other articles of diet which have been especially recommended are fish, especially oysters, leguminous foods, such as peas, beans or lentils, the latter especially in the form of revalenta arabica, and stout in moderation. The only drug likely to be of service is pilocarpin in small doses.

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* Ext. Belladon. gr. lx.; glycerini ℥i.

Depressed nipples.—Flat or depressed nipples may be due to some extent to defective development, but are generally the result of the pressure of stays. The child, not being able to suck readily, may eventually refuse the breast altogether, or may cause much pain, or produce excoriations or fissures by its efforts.

Treatment.—In this condition good may often be effected by drawing out the nipples by means of a breast-glass attached to an india-rubber tube and mouth-piece, and having a reservoir into which the milk falls. If, even after this, the infant is still unable to suck in the natural way, it may be able to suck through a glass nipple-shield to which is attached an india-rubber nipple, like that of a feeding-bottle.

Excoriations and fissures of the nipples.—Excoriations and fissures are most common in primiparæ, in whom the skin is generally more tender. They are also more liable to occur when the nipples are depressed, or when there is a deficiency of milk, so that the infant has to make unusual efforts in sucking. They are promoted by any want of cleanliness or want of care in drying the nipples either in pregnancy or lactation.

Excoriations are generally situated near the apex of the nipple. They may commence by elevation of the macerated epithelium in a small vesicle. If an excoriation is continuously irritated it may proceed to ulceration, and cause actual loss of substance of the nipple. Fissures are generally transverse, at the base of the nipple. Both excoriations and fissures may bleed. The child then swallows the blood with the milk, and may vomit it again afterwards. It will also be passed per rectum, and thus constitute one of the forms of melœna in the infant.

Both excoriations and fissures are apt to cause great agony in suckling, and make the mother dread the application of the child to the breast. Even a very minute fissure may cause this intense suffering; and hence it is necessary to make a very careful examination whenever pain in suckling is complained of. These conditions of the nipple are among the most important causes of inflammation and abscess of the breast.

Prophylaxis.—During pregnancy the nipples should be washed frequently, and the epithelium should not be allowed to accumulate, so as to leave tender spots on its detachment. In primiparæ, especially if the nipples are tender, it is desirable to harden the skin before delivery by washing with spirit or a solution of tannin. During lactation, the nipples should be carefully washed and dried after each time of suckling.

Treatment.—The lotion recommended by Playfair, consisting of half an ounce of sulphurous acid, half an ounce of glycerine of tannin, and an ounce of water, often does great good. The fissures or excoriations may also be touched once a day with a solution of nitrate of silver (gr. x. ad ℥i.). Some recommend touching with the solid stick of nitrate of silver. Fordyce Barker recommends the application of the compound tincture of benzoin. It is frequently found that less pain is produced if the child sucks through a glass nipple-shield. This plan does not, however, answer so well for fissures at the base as for excoriations at the apex of the nipple. If the fissures or excoriations do not otherwise heal, suckling with the affected breast should be discontinued for a day or two. This will generally allow them to heal without putting an end to lactation altogether.

Mastitis :—Mammary abscess.—At the time when the secretion of the milk commences it is common, especially in primiparæ, for the breasts to become unequally swollen, knotty, and painful. This condition arises from obstructions in the lacteal ducts, preventing a free outflow of the secretion. When the child has been lost, and the breasts are therefore not relieved by its sucking, the glands may be more uniformly affected in a similar way. In either case, the condition may amount to actual inflammation. There may be elevation of temperature and pulse, as well as local pain, swelling and tenderness, and sometimes even rigors occur. Thickened lymphatics may be traced, running to the axilla, and the axillary glands may become swollen. It is very rare, however, for this form of inflammation, without other cause, to go on to the formation of abscess, and it almost always ends in resolution.

Abscess in the breast, in the great majority of cases, is due to excoriation or fissure of the nipples. Probably in most cases the lacteal ducts become affected, in consequence, by catarrhal inflammation, microbes of suppuration having found an entrance from without, and at the same time obstructed. The inflammation extends backward along the ducts to the lobules of the gland ; thus a portion only of the gland is affected as a rule. Small collections of pus are formed at first; these unite and form a larger abscess-cavity. Not unfrequently, after the opening of a first abscess, one or more subsequent abscesses are formed in other lobules, different foci of inflammation having suppurated in succession. In other cases, the inflammation may extend from the nipple, not along the lacteal ducts, but through the cellular tissue, chiefly by the lymphatics.

Abscess of the breast, in accordance with the view given above as to its causation, rarely appears within the first few days after delivery. More frequently it occurs about the third or fourth week, and sometimes even at a later period. It occurs chiefly in anæmic and debilitated women. Those cases which do not commence within the first two months after delivery are observed chiefly in women who are weakened by prolonged lactation; as, for instance, when suckling is prolonged for eighteen months or more—a not uncommon case among the lower classes. Sometimes an abscess has followed sudden cessation of suckling, when the glands are in full activity. Occasionally it has been observed in pregnancy, or in women not suckling their children. In rare cases, a blow or other injury appears to be the starting-point of the inflammation. In still more rare cases, abscess, or even sloughing, of the breast, forms a part of a general septic infection, and occurs shortly after delivery. Micrococci may generally be found in the pus of a mammary abscess. These probably gain access, for the most part, through the lacteal ducts.

The most common form of inflammation leading to abscess is what is called "parenchymatous mastitis," in which the glandular substance and areolar tissue of a portion of the mamma are involved in inflammation together. The lacteal ducts belonging to the affected acini become obstructed. Sometimes, as the abscess enlarges, it may burst into a large lacteal duct. The pus may then be discharged from the nipple with the milk; or, if the abscess also opens externally, a lacteal fistula may remain at the point of opening, through which the milk escapes, and which sometimes is found difficult to close.

Symptoms and course.—The inflammation begins with acute pain and pretty severe constitutional symptoms. There is considerable elevation of pulse and temperature, general malaise, and usually rigors at the commencement of suppuration. The temperature often subsides somewhat after a few days, but pain usually continues until the pus has escaped. A hard and very tender swelling is found at the site of inflammation.

As the case progresses, the skin becomes reddened, and eventually glazed and œdematous, and fluctuation becomes manifest as the pus approaches the surface. If the abscess is left to nature, it often bursts by a small opening; the pus does not escape freely, and the different foci of suppuration communicate also by narrow openings. A large part of the mamma may thus be undermined. Openings may also take place at several points, and the breast may thus become riddled with fistulous tracts. In such cases suppuration may continue for months, and the strength be greatly reduced. When the patient is exposed to insanitary conditions, sloughing of undermined tissue may take place, and hæmorrhage may occur from vessels laid open.

Supra-mammary abscess.—Sometimes the inflammation affects, not the gland-tissue itself, but the areolar tissue over it. The starting-point is the nipple, or some of the small glands surrounding it, and either the areola only may be involved, or the cellular tissue over a wider surface. A superficial abscess, generally of no great size, is thus formed.

Sub-mammary abscess.—In other cases the site of abscess formation is the layer of areolar tissue beneath the breast. Inflammation generally spreads to this from the deeper portion of the gland itself. The abscess is then usually extensive. The whole mamma becomes prominent: there is deep-seated pain and tenderness, but not so much superficial tenderness; pain on movement of the arm is greater than in ordinary mammary abscess. The abscess generally opens at the border of the gland, toward the outer and lower part, often in several places. This variety is the rarest of all.

Treatment.—If there are signs of inflammation on the first establishment of the secretion of milk, saline laxatives, such as sulphate of magnesia, are to be given. If the child is to be suckled, gentle frictions with oil in the direction of the nipple are to be employed. If the child is feeble in sucking, a little milk may be drawn now and then with a breast-glass, with a view to clearing the ducts. If, however, the child is dead, it is better to treat with belladonna or atropia, and apply gentle pressure in the mode already described (see p. 288).

When abscess is threatened, the first essential is to take away the child from the breast—at any rate, from the side affected. If necessary, some milk may be squeezed from the affected side by gentle pressure, or a little may be drawn off by the breast-glass. Saline aperients should be given, and opiates for the relief of pain. Poultices give much relief, but they are undesirable so long as there is a hope of avoiding suppuration, and also after the abscess has been opened. In the latter case they cause maceration of the skin and prolong the suppuration. Strict rest should be maintained. The patient should be kept in bed, and the arm kept to the side.

Gentle uniform pressure is also useful. This may be applied by carefully strapping the breast, the strapping not being warmed at the fire, but dipped in hot water, so that it may become more pliable, and adapt itself more completely to the shape of the breast. At this stage it is better to use cold than heat. Dry cold may be applied by means of a bag of ice, or a Leiter's temperature regulator (see p. 813), through which a stream of ice-cold water is kept running.

The stage at which poultices are useful is when it is clear that suppuration has commenced, or is inevitable, but the pus is not yet near enough to the surface to be evacuated. As soon as it is obvious at what spot the abscess is commencing to point it should be opened. In general it is well to wait until this is evident to the eye; but in some cases, when there is an unusually deep abscess and severe constitutional symptoms, it may be desirable to explore with an aspirator-needle.

The abscess should be opened with antiseptic precautions, and an anæsthetic may be given with advantage. The line of incision should radiate from the nipple, so as not to divide the lacteal ducts. The incision should be fairly deep and wide, and all the pus, with any loose shreds of tissue, should be squeezed out by gentle pressure. A drainage tube may then be introduced, and cut off level with the skin, the end being secured by threads which pass through it, and lie upon the skin beneath the antiseptic dressings. The incision is covered with antiseptic gauze in the usual way, and this is kept in place by a gauze bandage, by which gentle pressure is made upon the breast. The dressings need not be changed more than once in two or three days, unless any discharge makes its appearance through the gauze.

A superficial supra-mammary abscess is easily opened by a free incision radiating from the nipple. It is better not to include the areola in the incision, if it can be avoided, lest the nipple be drawn aside by the cicatrix. A sub-mammary abscess should be opened, if possible toward the outer and lower part. An exploring-needle may be required, to make sure of the locality of the pus.

Tonic treatment, especially quinine and iron, will be called for, and the strength should be supported by nutritious diet. In general it is better to wean the infant altogether.

If the abscess has been neglected in the first instance, and the suppuration is prolonged, and fistulous openings remain, the openings may be enlarged, the finger passed in to break down partitions in the abscess cavity, and drainage tubes introduced. The cavity may be washed out at intervals with a solution of iodine (Tr. iodi. ʒii. ad aq. O i.), or chinosol (1 in 2,000). Closure of the sinuses is promoted by well-adjusted pressure.

Galactocele.—In very rare cases a collection of milk is formed through obstruction of one of the lacteal ducts. After a time the milk generally becomes thick and cheesy, through absorption of the watery portion, or it may separate itself into a thin and a thicker part. The swelling is generally only of moderate size, but has been known to attain enormous dimensions. The skin may give way eventually, or the cyst-wall may give way, and the milk become extravasated in the breast.

Treatment.—The swelling should be incised, and the further secretion of milk stopped by weaning the infant.

END

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